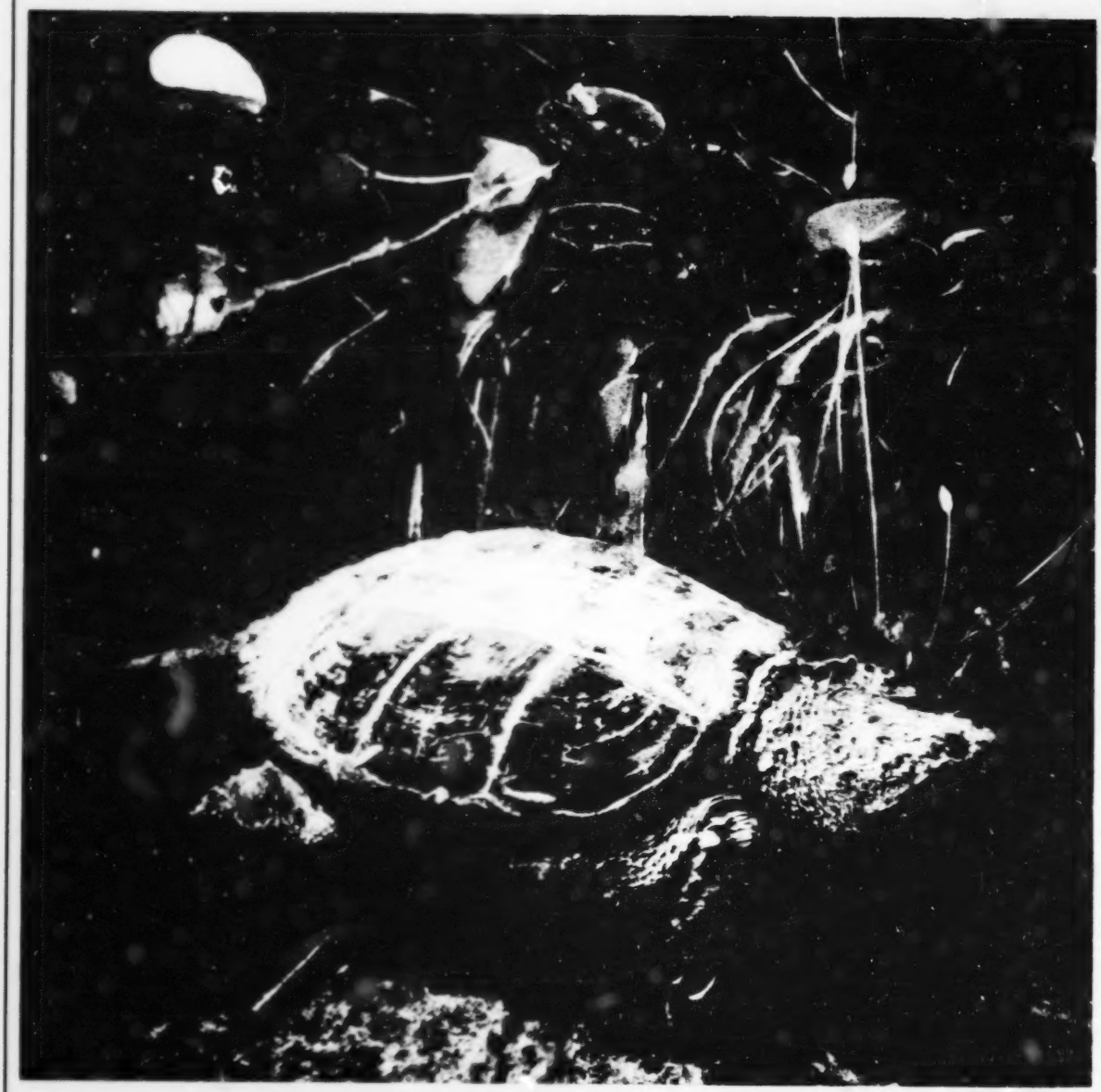
Amphibians and Reptiles of Nova Scotia

John Gilhen



Nova Scotia Museum

Amphibians and Reptiles of Nova Scotia

John Gilhen

Photographs

by

Ronald Merrick

Watercolours and Line Drawings

by

Frederick Scott

Nova Scotia Museum

Halifax, Nova Scotia

1984

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Published by
The Nova Scotia Museum
as a part of
The Education Resource Services Program
of the
Department of Education
Province of Nova Scotia

Hon. Terence R. B. Donahoe
Minister

Gerald J. McCarthy
Deputy Minister

Design by Nova Scotia Museum

Produced by
the Nova Scotia Department of Government Services
Information Services Division

Printed in Canada

Canadian Cataloguing in Publication Data

Gilhen, John, 1941-
Amphibians and reptiles of Nova Scotia

Bibliography: p.
Includes index.
ISBN 0-919680-25-9 (bound). — ISBN 0-919680-26-7 (pbk.)

1. Amphibians — Nova Scotia. 2. Reptiles — Nova Scotia. I. Merrick, Ronald E. II. Scott, Fred, 1942-. III. Nova Scotia Museum. IV. Title.

QL654.G54 1984 597.6'09716 C84-093503-X

To my parents

Flora and Augustus Gilhen

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Preface

In over 118 years of sporadic amphibian and reptile studies in Nova Scotia only one popular publication has been produced. Between 1953 and 1955, J. Lynton Martin, then biologist of the Nova Scotia Museum of Science, produced three short papers for the *Journal of Education* in an effort to inform teachers and students of the various species of salamanders, frogs, turtles and snakes of this province. In 1969 these articles were combined in a booklet and made available to the general public. Most of the information obtained over the years about the amphibians and reptiles of Nova Scotia was published in the *Proceedings* of the Nova Scotian Institute of Science, *Canadian Field-Naturalist*, *Copeia* and National Museum of Canada *Bulletin*. Although these publications are available and useful to scientists and interested naturalists, they are neither easily obtained nor easily understood by the general public.

A great deal of information concerning distribution, morphology and natural history of these animals has accumulated since 1955, and as urban sprawl has brought many people into direct contact with a number of unfamiliar amphibians and reptiles there has been an increased demand for information about them. It is hoped that the general public, students, naturalists and scientists will find this publication a useful guide and that it will lead to a better understanding of these harmless and very useful animals.

With few exceptions, the accounts given here are based primarily on my own field investigations and laboratory studies from 1963 to 1982. All of my field notes and laboratory notes are on file at the Nova Scotia Museum. In this book no attempt has been made to compare Nova Scotian populations with other populations throughout the species' range. There is a great deal of work yet to be done on amphibian larvae. There are no reliable keys available for frog tadpoles.

Specimens were dissected to determine sex, identify prey in stomachs and to count eggs in females. Amphibian eggs were spread out in a petri dish and counted individually under a dissecting microscope, using a 4-digit hand counter.

Only the measurements of fresh specimens have been used in this book.

A general account of the distribution of each species is given because, with few exceptions, the maps show only the localities of extant collections and may not represent the complete distribution of a particular species.

The Nova Scotia Museum, Halifax, and the National Museum of Natural Sciences, Ottawa, house the two major collections of Nova Scotia amphibians and reptiles. Small but important collections also exist at the Royal Ontario Museum, Toronto, and the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania.

Acknowledgements

It is a pleasure to acknowledge colleagues and friends who over the years gave assistance and encouragement during the preparation of this book.

First, I thank J. Lynton Martin, Director, Nova Scotia Museum, for recognizing the need for a popular publication on the amphibians and reptiles of Nova Scotia and for giving me the opportunity to undertake the necessary field and laboratory studies.

Francis R. Cook, Curator, Herpetology Unit, National Museum of Natural Sciences, Ottawa, was consulted many times and his advice is highly valued. Derek Davis, Chief Curator of Science, and Barry Wright, Curator of Zoology, Nova Scotia Museum, assisted in the identification of stomach contents of the various species. Robert Grantham, Curator of Geology and Alex Wilson, Curator of Botany, Nova Scotia Museum, assisted in the identification of rocks and plants. Mr. Grantham also provided information on glaciation. Donald Baird, Director, Museum of Natural History, Princeton University, Princeton, New Jersey, provided details concerning the highlights of the fossil story. Brian Preston, Curator of History, and Ruth Whitehead, Curatorial Assistant, Nova Scotia Museum, provided information on the turtle pendant and the petroglyphs. Geoffrey Ward prepared the histograms and scattergrams.

I am grateful to the following persons who assisted in field work over the years, particularly during the cold, rainy nights of early spring and in early summer when blackflies, mosquitoes and wood ticks were most bothersome: David Blake, James Callaghan, John Chapman, Edward Claridge, David Coldwell, Ross Dobson, Paul Doleman, Jeffery Fehr, Dawn Gilhen, Gail Gilhen, Jonathan Gilhen, Michael Gilhen, Sherry Gilhen, David Gordon, James Harding, Gary Hardy, Michael LeBlanc, Albert Lee, Sean LeMoine, Alexander Livingston (deceased), David Livingston, Kevin Moore, John Silver, John Shuh, Fred Scott, Glendon Stevens, Pierre Taschereau, Azor Vienneau and Wayne Weller.

Many people have donated specimens to the herpetological collection of the Nova Scotia Museum over the years. I am particularly indebted to the following persons: Ken and Peter Bagnell, Neil Cameron, Michael Clancey, Edward Claridge, Irving Deale, Kevin Duncanson, Roy Gilkie, Stanley W. Gorham, Brenda Grantmyre, James Harding, Peter Hope, Roald Kittilson, Bernard LeBlanc, George MacInnis, Andrew MacDonald, John A. MacNeil, Donald McAlpine, Sam Mowat, Tim Randall and John Wright.

I would like to thank the following persons and institutions for the loan of specimens: Francis R. Cook, National Museum of Natural Sciences, Ottawa, W. Beverly Scott and E. J. Crossman, Royal Ontario Museum, Toronto, and Gary Corbett, Parks Canada, Halifax. C. J. McCoy, Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, measured and sexed the Cape Breton specimen of Four-toed Salamander preserved in the herpetological collection of that institution.

Francis Cook, Fred Scott and Raymond Simpson read and made many useful comments on the manuscript.

I am most grateful to my wife Gail for her patience and understanding during the many days and nights of field work.

Doris Butters and Connie Brooks provided their professional experience in typing the drafts of the manuscript.

February, 1983 John Gilhen

Introduction

Amphibians and reptiles belong to the phylum Chordata and along with the fish, birds and mammals comprise the sub-phylum Vertebrata. Fish, amphibians and reptiles are 'cold-blooded' or ectothermic, that is their body temperature is derived externally and varies according to the temperature of their environment, while birds and mammals are 'warm-blooded' or endothermic, their body temperature remaining relatively constant and being derived internally.

There are 3,260 known species of amphibians living in the world today. They have been grouped in three major orders, consisting of 154 species of caecilians (Order Gymnophiona), 336 species of salamanders (Order Caudata) and 2,770 species of frogs (Order Anura).

Most amphibians have a soft, moist glandular skin without scales (a few species of tropical caecilians have small scales embedded in the skin). Their toes do not bear claws. Amphibian eggs are covered by several transparent gelatinous envelopes. Most amphibians lay their eggs in water or in moist, sheltered places on land. Some species which lay their eggs on land remain with the eggs to protect them against predators. The eggs hatch into aquatic larvae which breathe by means of gills. The larvae may be free-swimming or may pass through the entire larval stage confined to the aquatic environment inside the egg capsule. Some larval amphibians have special common names: toad larvae are called polliwogs, frog larvae are called tadpoles.

There are 5,954 known species of reptiles living in the world today. They have been grouped in six major orders, consisting of 222 species of turtles (Order Testudines), one species of Tuatara (Order Rhynchocephalia), 3,307 species of lizards (Order Sauria), 2,267 species of snakes (Order Serpentes), 135 species of amphisbaenians (Order Amphisbaenia) and 22 species of crocodilians (Order Crocodilia).

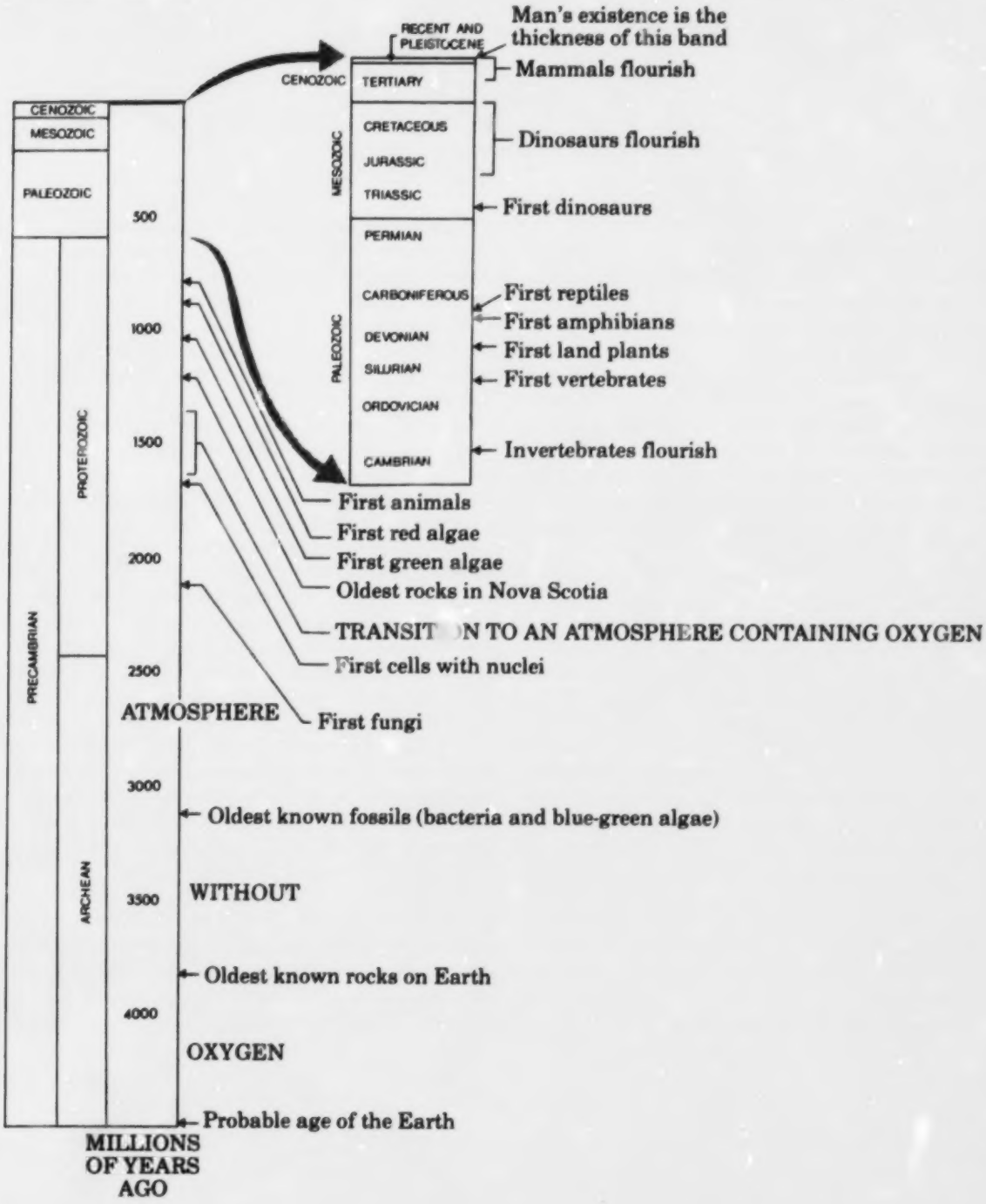
Reptiles have protective scales or shields, and those with limbs usually have claws. Reptile eggs have leathery shells, and are laid on land. Most turtles dig a nest and bury their eggs, while lizards and snakes deposit their eggs in secluded places, usually in or up against rotting wood or under boulders against the rootlets of vegetation. Some species of lizards and snakes remain with their eggs to defend them from predators. The length of time snakes retain their eggs inside the body before laying varies between species. Some retain their eggs until they are about to hatch.

The study of amphibians and reptiles is called herpetology. The word 'herpetology' is actually a combination of two words: 'herpeton' which means crawling thing, and 'logos' which means reason or knowledge. A person who studies these animals is called a 'herpetologist'. 'Herpetofauna' refers to the amphibians and reptiles of a given area.

The amphibians and reptiles present in Nova Scotia today have evolved from an ancient herpetofauna which existed and dominated the earth millions of years ago. The fossil remains of many representatives of these primitive animals have been found in this province.

Figure 1.

Geological Time Scale



Fossils: The oldest herpetofauna of Nova Scotia

Rugged mountains, lush rain forests growing in wide valleys, extensive floodplains, shallow lagoons, swamps, — all existing in a warm and humid climate. This was the tropical environment of Nova Scotia some 330 million years ago.

Fossilized evidence from Horton Bluff, Kings County, indicates that the oldest known amphibian of North America lived here during this early Mississippian time (Figure 1). They were alligator-shaped, about three feet long, and with a third eye (the pineal eye) in the middle of the head. They probably spent much of their lives in water, although the form of their limb bones suggests that they were capable of crawling and walking on land (Figure 2). There are no common names for these animals, but vertebrate paleontologists (people who study vertebrate fossils) know them as anthracosaurian labyrinthodonts. These amphibians are predated only by the fish-like amphibians called ichthyostegalians, found fossilized in rocks of latest Devonian age in eastern Greenland.

Near the beginning of the Pennsylvanian Period, some 310 million years ago, the oldest true reptile known from anywhere lived here. The front half of its skeleton, preserved in a block of sandstone, was found on the beach north of Port Hood, Inverness County (Figure 3). This reptile, which in life looked more like a salamander than any reptile living today, was perhaps 46 centimetres long and

Figure 2.

Fossil thigh bones (femora) of two anthracosaurian labyrinthodont amphibians which were found in grey shale at Horton Bluff, Kings County. These bones are currently under study by Dr. Donald Baird, Princeton University, New Jersey. The scale is in centimetres. Photographed by R. M. West

Figure 3.

Head and anterior trunk of *Romeriscus*, the earliest reptile known to science, embedded in a block of sandstone which was found on a beach north of Port Hood, Inverness County. Photograph from a colour transparency by Dr. D. Baird

had a relatively large head, nearly eight cm long. Like its ancestors, the labyrinthodont amphibians, it had a third eye in the middle of the head. It has been given the name *Romeriscus* and assigned to the group of cotylosaurs or stem-reptiles from which all other reptiles are believed to be descended.

Over millions of years a great variety of labyrinthodont amphibians and stem-reptiles evolved to occupy the coal forests and a variety of other habitats that once flourished here (Figure 4). How long each species existed depended on its ability to adapt to changing conditions. The evolution of new and more efficient competitors was a threat which they had to overcome or else be eliminated.

The fossil bones and footprints of some of these early amphibians and reptiles have been found in a number of rock formations in the Coal Measures of Nova Scotia. The most productive localities for labyrinthodont amphibian fossils are Point Edward, Grand Etang and Florence on Cape Breton Island, and Joggins and Parrsboro on the mainland. The youngest examples, in geological terms about 290 million years old, are skeletons found fossilized in upright trees near Florence in the Sydney Coalfields.

Figure 4.

A model depicting a coal forest which flourished in Nova Scotia during the Pennsylvanian Period, some three hundred million years ago

Figure 5.

A fossil tree trunk embedded in the sea cliff at Joggins, Cumberland County. The remains of labyrinthodont amphibians and stem-reptiles have been found in Nova Scotia entombed in fossil tree trunks like this one

The skeletons of stem-reptiles have also been found fossilized in upright trees at Joggins (Figure 5) as well as Florence. Associated with them are rare remains of pelycosaurs, the earliest representatives of the mammal-like reptiles which in time gave rise to the mammals.

The Permian Period, 280 to 230 million years ago, was a time of erosion in Nova Scotia, leaving paleontologists little fossil record. Reptiles from this period, however, have been found on Prince Edward Island.

During the Triassic Period, about 230 to 195 million years ago, the scattered remains of a variety of reptiles became entombed in the reddish-brown sands which today form the sandstone cliffs of the Minas Basin area. Among the Triassic denizens were procolophonids (Figure 6), the last of the stem-reptiles, which were small, stocky vegetarians with bony spikes on their cheeks (thought to discourage predatory dinosaurs) and parrot-headed reptiles called rhynchosaurs (Figure 7), which are related to the Tuatara of New Zealand. Evangeline Beach in Kings County is the first locality in North America where rhynchosaur bones have been found. There were also long-nosed armadillo-like armoured reptiles called *Stagonolepis* (Figure 8), distant cousins of the crocodiles, which fed upon plants and the remains of dead animals, and bipedal flesh-eating dinosaurs called *Coelophysis* (Figure 9), which grew up to two and one half metres in height and three to six metres in length and were able to run on their muscular hind legs and capture other reptiles, which were grasped with the much smaller forelegs. The bones of a variety of other unnamed reptiles are also under study, including bulky inoffensive bipeds that were ancestors of the brontosaurs of later periods, and turkey-sized plant eaters related to stegosaurs and duckbilled dinosaurs.

During the late Triassic Period the last of the labyrinthodont amphibians, a big flattened pond-dweller named *Metoposaurus*, coexisted with these early dinosaurs. Its skull and other bones were found in the sea cliffs near Noel, Hants County.

Dinosaur footprints uncovered in Five Islands Provincial Park, Colchester County, bring the fossil record up to the beginning of the Jurassic Period.

The late Triassic and early Jurassic Periods were a time of earthquakes, volcanic activity, erosion and deposition. Faulting associated with the spreading of the continents created new highlands and lowlands. Sediments eroded from the uplifted block were deposited in the wide valleys. The forests, ponds and streams, along with many of their inhabitants, were buried. Following this time, no reptilian fossils are known from Nova Scotia.

Geologists tell us there is convincing evidence that Nova Scotia was positioned near the equator and was part of a much larger supercontinent, called Pangea, when these ancient amphibians and reptiles dominated the earth. Pangea began to rift and split into smaller continents approximately 180 million years ago. About 80 million

Figure 6.

A life-sized model of a procolophonid, the last of the stem-reptiles. This vegetarian, approximately 41 cm long, was an early relative of the turtles

years ago the present-day North Atlantic Ocean began forming when a rift split apart what are now North America and Europe. From that time on the North American continent has been moving westerly at an average speed of three centimetres per year.

The first evidence indicating that a primitive herpetofauna existed in Nova Scotia was discovered in mid-September of 1841 when Sir William Logan, a Canadian geologist, located fossil amphibian footprints at Horton Bluff. The animal responsible for the tracks was later named *Hylopus logani* by Sir William Dawson, a friend and colleague of Logan's and a native of Pictou. Since then the sea cliffs of Minas and Cumberland Basins have been prime study areas for paleontologists. During the summer of 1979, in the Horton Bluff area, staff of the Nova Scotia Museum prepared a fibreglass cast of the largest amphibian footprints ever recorded from rocks over 330 million years old (Figure 10).

Over the past 28 years, Dr. Robert L. Carroll of McGill University, Montreal, and Dr. Donald Baird of Princeton University, New Jersey, have studied the fossil sea cliffs of Nova Scotia. Complete fossil skeletons of the early dinosaurs have never been found but Carroll, Baird and other paleontologists can postulate from the shape and size of individual fossil bones and teeth the approximate size and shape of the animal, and gain some insight into its way of life. This information can be used for model reconstructions. Displays of these models offer the scientific community and the public an artificial view of a few representatives of the ancient herpetofauna of North America.

No one knows how many different species of these ancient amphibians and reptiles lived here. The number of species known is probably only a small proportion of those that once existed in this province, even for those brief spans of time during which fossils were preserved.

Figure 7.

A life-sized model of a rhynchosaur approximately one meter long. The bones of this reptile were first found at Evangeline Beach, Kings County

Figure 8.

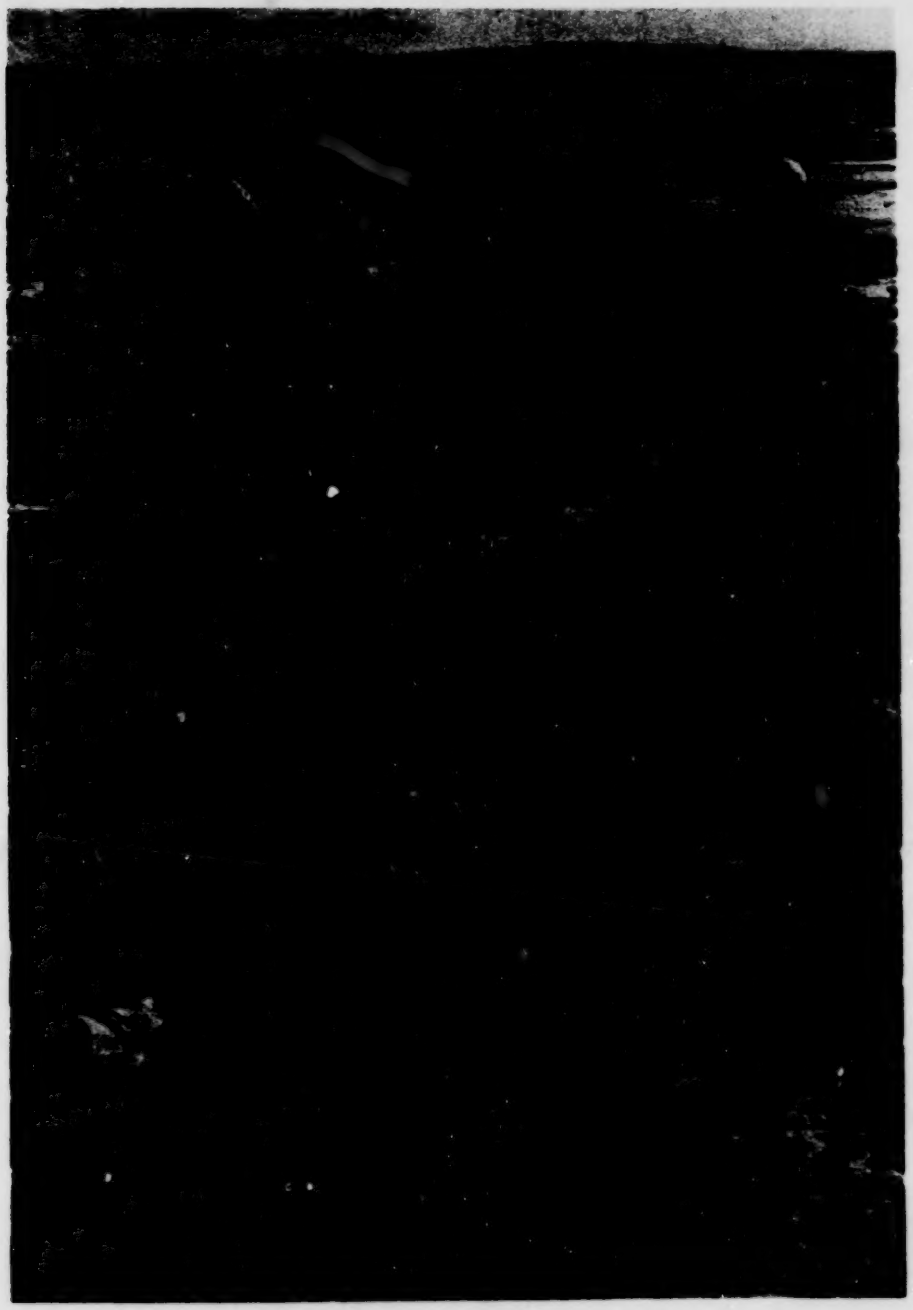
A life-sized model of *Stagonolepis* approximately 2.8 meters long. This long-nosed armoured reptile was a distant cousin of the crocodile

Figure 9.

A life-sized model of *Coelophysis*. This dinosaur was an agile predator. It grew up to two and one half meters in height and three to six meters in length

Figure 10.

Staff members of the Nova Scotia Museum on the shore near Horton Bluff, Kings County, preparing to make a fibreglass cast of fossil tracks of one of the ancient amphibians of early Mississippian time



Destruction and Recolonisation: The Ice Age and the aftermath in Nova Scotia

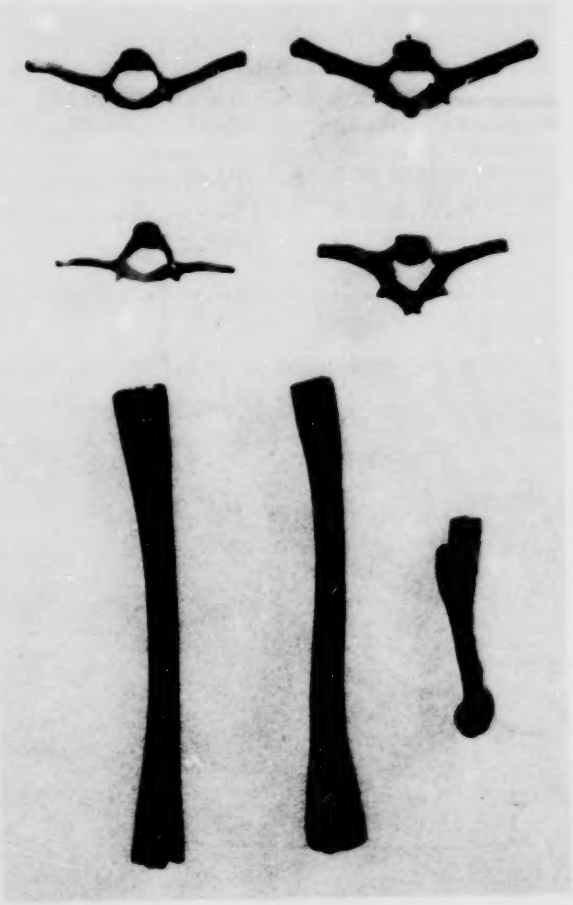
The beginning of the Quaternary period, about two million years ago, was a time of drastic climatic change in the world. Temperatures became much colder than we experience today. Glaciers formed, merging into extensive thick continental ice sheets which scraped the land bare. During the last one million years these polar ice-caps advanced and receded five to six times and covered about one-third of the land surface of the earth each time. The cause of a major glaciation is not totally understood. Most geologists believe we are at present in an interglacial stage.

The last major glaciation, known as the Wisconsin since the evidence of its effect is best exposed in that state, reached its height some 19 thousand years ago. A major section of that glacial ice, known as the Laurentide ice sheet, moved across the Maritime Provinces and blanketed Nova Scotia with ice several hundred metres thick. As the massive ice sheet developed, the sea level dropped because of the vast quantities of water tied up as ice. The ice extended beyond our present coastline and the sea level was reduced approximately 130 to 140 metres below today's level. The recovery of teeth from mastodons (hairy relatives of the elephants, which became extinct some time during the Pleistocene stage of the Quaternary) by trawlers fishing on Georges Bank, is convincing evidence that as the sea level dropped, the banks off Nova Scotia were exposed land masses, developed into lush island plains, and provided refuges for many species of plants and animals which colonized Nova Scotia during the interglacial times.

However, the amphibians and reptiles which thrived in Nova Scotia during interglacial periods were probably destroyed as a result of the harsh environmental conditions which led to the major glaciation. We know that amphibians were present during that time, for in the mid-1950's the bones of frogs (Figure 11) were found preserved in the muds

Figure 11.

Frog bones which were found preserved in the muds of a pond that existed during a warm period between major glaciations, some 50 thousand years ago. The pond occupied a gypsum sink-hole at what is now Milford gypsum quarry near the boundary between Halifax and Hants Counties



of a pond which existed during a warm period between major glaciations. The pond occupied a gypsum sink-hole more than 50 thousand years ago at what is now Milford gypsum quarry near the boundary between Halifax and Hants Counties.

About 14 to 12 thousand years ago the Laurentide ice sheet gradually melted. The retreating ice left behind the numerous lakes and streams which form the complex water-systems throughout Nova Scotia. Muds, sands and boulders which had been taken up and transported within the ice resettled upon the land. Specially shaped mounds of glacial till, called drumlins, which are common in south central Nova Scotia, and glacial erratics (boulders transported from one place to another by a glacier), examples of which can be seen at Peggy's Cove, Halifax County, are two of the most striking features resulting from glaciation. This newly-fashioned landscape eventually provided habitat for the amphibians and reptiles which recolonized this land.

Shallow ponds and lakes were more abundant during post-glacial time but many gradually became bogs as they filled with silt and vegetation, a process known as bog succession. Bogs have been of particular interest to scientists in recent years as they have provided many of the clues which have led to an estimate of the time since the last glaciation and a clearer understanding of the changing environmental conditions since then. A core sample extracted from a bog and analysed, contains debris, such as twigs, seeds, cones and insects, from various levels which may be dated by the Carbon-14 process. This provides the age of each layer in the bog. Scientists can determine the climatic conditions which prevailed at each stage of the life of the bog from the plant species, represented by pollen grains, which dominate each layer.

As a result of sophisticated studies of bogs, most scientists agree that from five to three thousand years ago Nova Scotia experienced an extended warm period, when temperatures were much warmer than at present (Figure 12). It was probably during this hypsithermal interval that the amphibians and reptiles made their greatest advance northward from unglaciated refuges to the south.

Since the ice melted away in a northwesterly direction, the east coast area was free of ice before the continental inland. Therefore, plants and animals spread northeast and eventually recolonized the Maritime Provinces. The amphibians and reptiles on Prince Edward Island and Cape Breton Island,

Figure 12.

Climatic change in Nova Scotia since the Wisconsin Glaciation (after Terasmae, 1975)

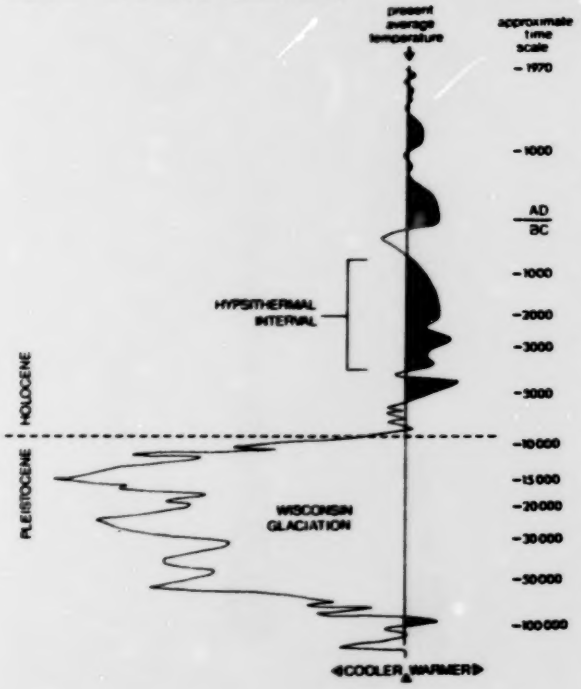


Figure 13a.

A hypothetical map of the Maritime Provinces during early post-glacial times, about 12,500 years ago, when glacial ice was retreating rapidly and the Maritimes were interconnected by land bridges (after Bousfield and Thomas, 1975)

Figure 13b.

A hypothetical map of the Maritime Provinces during late hypsithermal times, about 5,000 years ago, when glacial ice had disappeared, sea levels were rising and the land bridges interconnecting the Maritimes were greatly reduced in size (after Bousfield and Thomas, 1975)

Figure 13c.

A hypothetical map of the Maritime Provinces during post-hypsithermal times, about 3,000 years ago, when the land bridges which interconnected the Maritimes had submerged and the Isthmus of Chignecto was reduced to a salt marsh (after Bousfield and Thomas, 1975)

as well as on other smaller coastal islands off Nova Scotia, arrived there before the land bridges which interconnected these areas became flooded by sea water (Figure 13a, b and c). The flooding of these land bridges was a result of rising sea level brought about by the melting glaciers.

The Northern Dusky Salamander, *Desmognathus fuscus fuscus*, (Figure 14); Northern Two-lined Salamander, *Eurycea bislineata bislineata*, (Figure 15); and the Tetraploid Gray Treefrog, *Hyla versic-*

Figure 14.

Northern Dusky Salamander from Browns Flats, New Brunswick, collected May 16, 1982

olor, (Figure 16), are three amphibians found in New Brunswick but not in the rest of the Maritimes. Since suitable habitat for these species is common in Nova Scotia and the climate here is at least as favourable as in New Brunswick, they must have been slower in spreading northeast and by the time they arrived in New Brunswick, the rising sea level created an extensive saltmarsh at the Isthmus of Chignecto, establishing a natural barrier to their spread into this province.

The Stinkpot, *Sternotherus odoratus*; Spotted Turtle, *Clemmys guttata*; Northern Water Snake, *Nerodia sipedon sipedon*, (Figure 17); Northern Black Racer, *Coluber constrictor constrictor*; and Eastern Milk Snake, *Lampropeltis triangulum triangulum*, are five reptiles whose distribution includes a finger-shaped coastal extension into eastern Maine. If one or more of these species colonized the Maritimes during the hypsithermal interval, they may have been gradually eliminated by the cooling climatic conditions, which also restricted the populations of the Blanding's Turtle, *Emydoidea blandingi*, and Northern Ribbon Snake, *Thamnophis sauritus septentrionalis*, to south central Nova Scotia, where the mean annual temperature is higher than in any other region in the Maritimes. Following this reasoning, the amphibians and reptiles inhabiting Nova Scotia during interglacial times did not escape to offshore island refuges, but were eventually eliminated some time before the land became glaciated. Perhaps future studies of interglacial bogs will reveal the preserved identifiable remains of a number of these immigrants which no longer exist in this province today.

Figure 16.

Tetraploid Grey Treefrog from Barkers Point near Fredericton, New Brunswick, collected June 1982

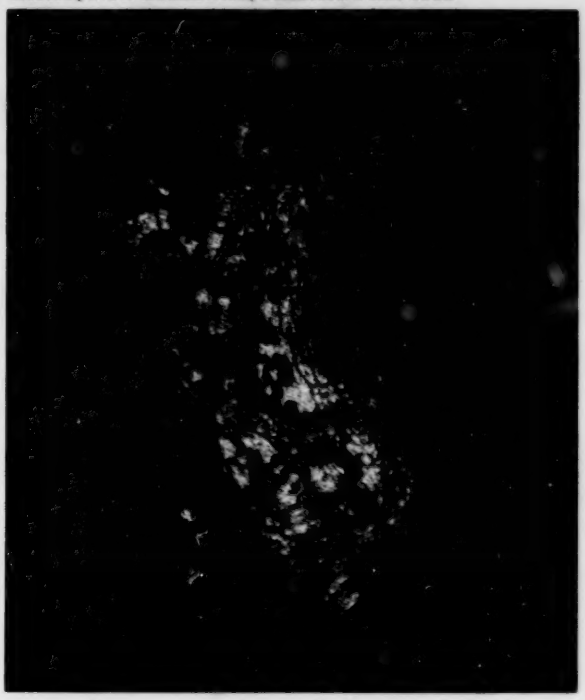
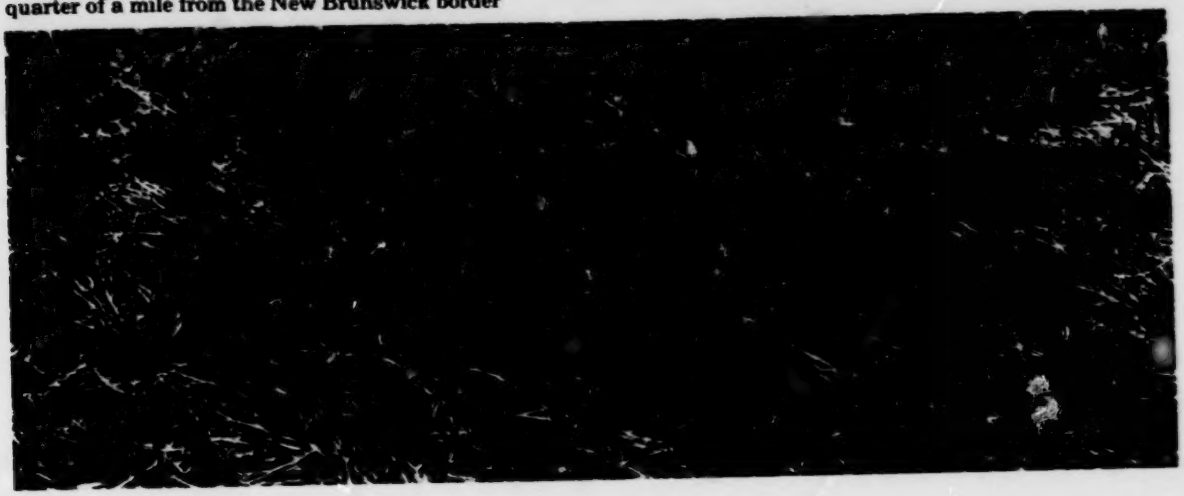


Figure 15.

Northern Two-lined Salamander from Browns Flats, New Brunswick, collected May 18, 1982

Figure 17.

Northern Water Snake from Moose Horn Wildlife Refuge, Maine, August 1980. This locality is about one-quarter of a mile from the New Brunswick border



History of herpetology in Nova Scotia

The first evidence indicating that man coexisted with, and was aware of, amphibians and reptiles in this province dates back to more than 350 years ago, when one of the early inhabitants fashioned a siltstone pendant in the shape of a turtle (Figure 18). This pendant was found in gravel along the Mersey River, east of Lake Rossignol, Queens County, in the late 1960's.

The Micmac Indians were very familiar with the larger forms of life around them. A variety of animals that were of cultural significance can be seen in the form of pictures scratched onto exposed rock in the shallows of Kejimkujik Lake, Queens County. Snakes, which were looked upon with awe and suspicion, are represented there (Figure 19). One of the petroglyphs depicts the great horned snake, a famous creature of Micmac legend.

Nicolas Denys was one of the early French immigrants to settle in Nova Scotia. He founded fishing and lumbering establishments at Rossignol (Liverpool-Milton area), Queens County and LaHave, Lunenburg County, beginning in 1632; and in 1653 he established a fur-trading post at St. Peters, Richmond County. Denys was interested in the natural history of Acadia and wrote about the various animals which inhabited the woods. He was first to report that the snakes in Nova Scotia are harmless and to indicate that native turtles were a source of food for the early settlers.

A translation of Denys' account of "the Snakes" is as follows: "There occur also throughout that country plenty of Snakes, of all colours, in the woods. Nevertheless they have never yet been known to injure Indians or French. Although they are stepped on they do no injury in that land."

Denys included turtles in his accounts of the

Figure 18.

A turtle-shaped pendant, fashioned out of a piece of siltstone by an inhabitant of Nova Scotia over 350 years ago

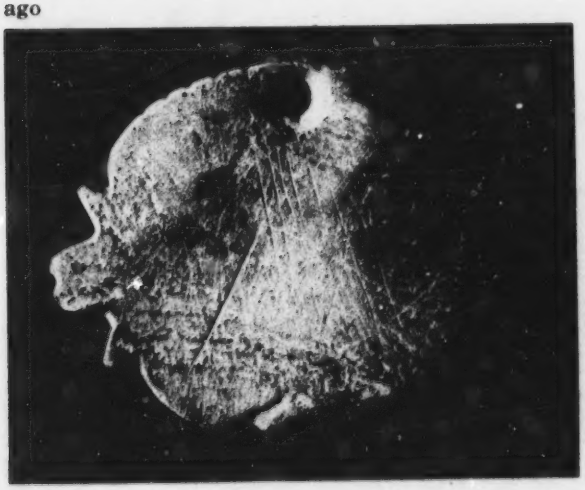


Figure 19.

A petroglyph of a snake on exposed slate rock at Kejimkujik Lake, Queens County

fishes and mentioned capturing them in ponds where "little Salmon Trout" were taken on hook and line. A translation of his information on turtles reads: "In the same ponds is taken the Tortoise. Some of them are found as large around as the circumference of a hat. The shell above is streaked with red, white and blue colours. It is a very good fish. Being boiled, the shell is removed: then it is skinned. It is cut into pieces and served as a stew or a fricassee with a white sauce. There are no pullets which are as good as this." Denys is probably referring to two species of turtle, the one "as large as the circumference of a hat" being the Common Snapping Turtle, while those streaked with red would be the Eastern Painted Turtle. Both species are common in ponds and lakes in Lunenburg and Queens Counties.

Dr. Robert Hale Jr., of Beverly, Massachusetts, made a voyage to Nova Scotia in 1731 during which he kept a journal. After an overnight visit in Annapolis he and his company, which included Governor Cosby and his men, started out for Chignecto. Somewhere along the coast of Annapolis County they anchored and came ashore. There Hale killed two snakes because he thought they looked like adders. They were probably Maritime Garter Snakes. Hale's entry for 6 P.M., Tuesday, June 22, reads: "Wee went a shore & I seeing some Fir Trees endeavor'd to get the Balsom which is pretty plenty but the Knats & Muskettoes being very plenty also, I was soon forc'd to give over; as I was going down, I saw 2 Speckled Snakes or like Adders upon the Beach, such as I never saw before, which I killed."

In his book, *A General Description of Nova Scotia*, published in 1825, Thomas Chandler Haliburton listed the native mammals, birds, fish, marine invertebrates and insects. The only mention he makes of the herpetofauna is in pointing out: "There are no venomous snakes or dangerous reptiles in Nova Scotia."

On July 2, 1851, Horatio Robinson Storer read at a meeting of the Boston Natural History Society some conclusions concerning range extensions of certain North American amphibians and reptiles. His information, published in the proceedings of the society, provides us with the first list of amphibians and reptiles native to Nova Scotia. He comments on the following species:

Eastern Garter Snake
"Found throughout the United States, and by Agassiz near Lake Superior. Taken by Prof. Wyman and myself in Nova Scotia."

Green Frog
"Thus far Maine has been its Northern limit. Found by us in Nova Scotia."

Northern Leopard Frog
"Has been taken in Massachusetts, — by us in Nova Scotia."

Wood Frog
"Taken in Massachusetts, — by us in Nova Scotia."

American Toad
"By Holbrook, in the interior of Maine, and by Agassiz at Lake Superior. I have taken it at Eastport, Me., and in Nova Scotia."

Eastern Redback Salamander
"At Lake Superior, by Agassiz, and in Massachusetts. By Dr. Wyman and myself in Nova Scotia. By myself at White Mountains."

Captain Campbell Hardy, an Englishman, had a great desire as a youth to travel and camp in the woodlands of Canada. In 1852, at the age of 20, he came to Halifax as a lieutenant in the Royal Artillery and he remained here until 1867. He became a well-known sportsman, naturalist, artist and writer (Piers, 1919). During his stay in Nova Scotia he became a good friend of Andrew Downs, a naturalist who maintained the first North American zoological gardens near the head of the North West Arm. Downs was a great source of information for Hardy, helping him to identify the various animals he observed in the forests of this province.

Hardy was impressed by the loud choruses of Northern Spring Peepers that he heard during the spring, but at first he attributed the sound to Green Frogs. In a section called "The Nova Scotian Nightingale" of Chapter II, volume 2, of his book *Sporting Adventures In The New World; or, Days and Nights of Moose-hunting in the Pine Forests of Acadia*, published in 1855, he wrote: "Throughout the night and a great part of the day, emanating from every roadside swamp in Nova Scotia, may be heard, with the occasional dull, booming croak of the bull-frog, the noisy clamour of the marsh frogs. It is like the chirruping of a multitude of small birds, a circumstance which has procured for the reptile the appellation of the Nova Scotian nightingale. They are prettier creatures than the English frogs. Their skin is of a bright golden colour, and the back and side of the head are of an emerald green.

"Their piping, and the tinkling of the cattle bells in an adjacent meadow, at length made us feel suf-

ficiently drowsy to re-enter the house, and so to bed."

Hardy eventually learned to recognize the voice of the Northern Spring Peeper, as well as the sound produced by the Green Frog and the Eastern American Toad. In 1869 he published a second book entitled *Forest Life in Acadia* and in Chapter XII, "The Progress of The Seasons" he wrote, "The swamp vegetation headed by the Indian cup (Sarracenia purpurea) and blue flag (Iris versicolor), flowers abundantly in the ponds and moist hollows in the woods, the dark-red drooping petals of the former prettily contrasting with the blue of the iris. The large, yellow-throated frog (Rana fontinalis) [Green Frog] here rules the world of reptile life; his solemn ejaculation — 'glum! glumph!' is heard in every direction and at regular intervals, mingled with the long trilling love-note of Bufo Americanus — the common toad [Eastern American Toad] — and the sharp ceaseless cries of the little Hylodes (H. Pickeringi) [Northern Spring Peeper]."

In 1863, A. E. Verrill published a paper, in the *Proceedings* of the Boston Society of Natural History, entitled "Catalogue of the Reptiles and Batrachians Found In The Vicinity of Norway, Oxford Co., Me." Although his paper concerns the distribution of the species in Maine, he collected specimens on Cape Breton Island. He includes "Breton Island, Nova Scotia" in the distribution of the following species: Eastern Smooth Green Snake, American Toad, Northern Leopard Frog and Eastern Redback Salamander.

Verrill also mentioned that he found the last-named species on islands in the Bay of Fundy.

The Nova Scotian Institute of Science was founded in Halifax in 1862. The *Transactions* of the Institute provided an opportunity for naturalists and scientists to publish their observations and the results of their studies.

John Matthew Jones, F.L.S. (Figure 20), third president of the Nova Scotian Institute of Science, was first to do a study of the herpetofauna of Nova Scotia. His paper, entitled "Contributions To The Natural History of Nova Scotia: Reptilia", was published in the *Transactions* of the Institute in 1865. Jones' paper was a major contribution because it provided a base for future herpetological fauna studies. It is interesting to note that at that time amphibians and reptiles were grouped together in the class Reptilia.

Jones considered the study of Reptilia to be an ignored field of science. In his opening paragraph he wrote, "In the early days of science, when natural history had few students, and even down to a comparatively recent period, the study of reptiles was almost totally neglected; and in the museums of diverse countries a few stray bottles full of snakes and lizards, unnamed and uncared for, lying in some obscure corner, and deemed too disgusting for the eyes of visitors, were the only representatives of this singular race of creatures. It is far different, however, now, for in our splendid national museum we possess a collection which for interest can hardly be surpassed by other zoological departments, while, both in Europe and America, the study of Herpetology has become a prominent branch of scientific research."

Jones includes a general discussion concerning world distribution of amphibians and reptiles. He points out that the greatest number of species and the largest species are found in the warmest regions of the world. He also gives the elevation limits of certain foreign species.

The accounts of the salamanders, frogs and

Figure 20.

Portrait of John Matthew Jones, 1828-1888. Jones was the first to review the herpetofauna of Nova Scotia

snakes given by Jones are based primarily on four years' field experience in the forest and cultivated land about his two homes, at 114 Tower Road, Halifax, and at Ashbourne, Halifax. However, he includes all the reports that were made available to him, particularly those of his colleagues, Rev. John Ambrose and Captain Hardy. His accounts of the turtles are based on information he received from a colleague, Dr. J. Bernard Gilpin. Jones gives a history of the nomenclature and an account of the following species of amphibians and reptiles: Common Snapping Turtle, Eastern Painted Turtle, Wood Turtle, Northern Black Racer, Northern Ringneck Snake, Eastern Smooth Green Snake, Maritime Garter Snake, Northern Redbelly Snake, Bullfrog, Green Frog, Northern Leopard Frog, Wood Frog, Eastern American Toad, Northern Spring Peeper, Tetraploid Gray Treefrog, Yellow-spotted Salamander, Red-spotted Newt (terrestrial juvenile and aquatic adult).

There is no evidence of breeding populations of Northern Black Racer or Tetraploid Gray Treefrog in Nova Scotia (see Chapter VI).

In his closing paragraph, phrased in Victorian naturalist style, Jones advised that we are fortunate there are no poisonous snakes in Nova Scotia. He wrote, "in the northern States of America, the dreaded rattlesnake swarms in some parts, the bite of which is frequently fatal in twenty minutes; while here, in our little half-island home, our children may ramble wherever they list, and meet with nothing more formidable than the bite of the common striped snake [Maritime Garter Snake], which at the worst can only inflict a slight wound in no way dangerous to a healthy frame. Therefore, while in other climes which boast of the grandeur of their scenery, the beauty of their vegetation, or the vast area of their fertile lands, deadly foes are ever ready to spring upon the incautious, here in our northern home we may roam through the forests, scale our boulder ridges, or bathe in the limpid lake, without hindrance from any reptile form. Surely we ought, therefore, to consider how blessed we are in this respect, and while considering the blessing let us not forget the beneficient hand that has so blessed us; and as we roam in security amid Nature's pleasantest scenes, let us lift our eyes in gratitude to Him who has spared us the horrors of the serpent's fang."

In 1866, John Ambrose contributed an interesting observation concerning an Atlantic cod, *Gadus morhua*, preying on an American Toad. The account is part of a general discussion of the diverse feeding habits of this species of fish in a paper entitled "Some Observations On the Fishing Grounds And Fish Of St. Margaret's Bay, N.S." published by the Nova Scotian Institute of Science. Ambrose wrote, "When I was at Economy, N.S., in the month of March, 1864, a cod was caught near that place with a toad in its stomach. This unfortunate toad had, no doubt, on the approach of cold weather buried himself in some suitable place, but too near the edge of one of those sandy cliffs which overhang the rushing tides of the Basin of Minas, and this falling off at the coming out of the frost had carried with it the semi-conscious toad, to serve as a meal for the hungry cod prowling below."

In 1868 J. M. Jones added another species to the herpetofauna of Nova Scotia. His paper entitled "On *Hyla Squirella* a Batrachian, — New To The Province", published in the *Proceedings* of the Nova Scotian Institute of Science, is based on information he received from Mr. Arthur Silver. Jones stated, "Through the assiduity of Mr. Arthur Silver, I am now enabled to add another species to the list, viz.: The Squirrel Treefrog, or Little Peeping Hyla (*Hyla squirella*)." There is no evidence of a breeding population of the Squirrel Treefrog in Canada, and the frog referred to was probably the Northern Spring Peeper (see Chapter VI).

In 1875 J. Bernard Gilpin published in the *Transactions* of the Nova Scotian Institute of Science a paper entitled "On The Serpents of Nova Scotia". His paper begins with a systematic list of species, followed by a three-paragraph introduction including remarks about evolution, physiology and behaviour of vertebrates in general.

Gilpin gives an account of the following species: Maritime Garter Snake, Northern Black Racer, Eastern Smooth Green Snake, Northern Ringneck Snake and Northern Redbelly Snake.

A number of inaccuracies and contradictions are evident in Gilpin's paper. For example, following the accounts of the species he labours on in his belief that snakes swallow their young to protect them in times of danger, a misconception that persists to the present day. Gilpin believed all of the native snakes he reported on were egg layers (oviparous). However, two species he discussed, the "Red Bellied Snake" and the "Garter Snake", actually bear live young (viviparous). Gilpin said, "Of the five species in Nova Scotia, we have personally identified their eggs . . ." However, in his

Figure 21.

Portrait of Harry Piers, 1870-1940, by LeRoy Zwicker. Piers made many valuable detailed descriptions of amphibians and reptiles native to Nova Scotia in his museum accession books

account of the "Red Bellied Snake" he said "I have no notes of its habits and have never seen its eggs."

Gilpin makes an important contribution by reporting on two snake hibernacula in his account of "The Garter Snake".

His closing paragraph, also phrased in the style of a Victorian naturalist, reads: "Our arctic climate but ill accords with this child of the sun. Grey colours deck him, nor can our slanting sun rays nourish him to the huge proportions of the tropic, or concentrate his poison to their deadly power; yet slow as his action comparatively is, deliberate as his rustle through the dried grass is, his old historical name, his obscure attributes, used of old in true religion and false enchantment, as well as his present, extreme abstemiousness joined to an extremer gluttony, and his magnificent repose, the extremities so coiled, that the sleepless eye and forked tongue of the centre guards all, a very type of citadel, will make him a fascinating study to all for all time."

Harry Piers (Figure 21) was very interested in documenting the occurrences of species new to, or considered rare in, Nova Scotia. He contributed many valuable details concerning the distribution, morphology and natural history of a great variety of animals in a series of papers entitled "Notes on Nova Scotian Zoology" which were published in the *Transactions* of the Nova Scotian Institute of Science. Three of his papers include a section on reptiles. In 1890 he reported on a "Leather Turtle (*Sphargis coriacea*)" (Atlantic Leatherback) and a "Black Snake (*Bascanion constrictor*)" (Northern Black Racer). In 1892 he reported on a "Ring Snake (*Diadophis punctatus*)" (Northern Ringneck Snake), and a "Vermillion-spotted Newt (*Diemyctylus viridescens*)" (red-eft or juvenile Red-spotted Newt). In 1897 he reported on another "Ring Snake *(Diadophis punctatus)*", another "Trunk-Back or Leather Turtle *(Dermocheyls coriacea)* and another, "Red Eft *(Diemyctylus viridiscens = miniatus)*". His 1890 report of an Atlantic Leatherback is the first documented occurrence of that species in the coastal waters of Nova Scotia. Piers gave a description of each species except the "Black Snake". His inclusion of that species is based on a recollection from at least three years previous to 1890.

Harry Piers was a very knowledgeable and highly skilled professional museologist. During his career, from 1899 to 1940, as curator of the Provincial Museum he made 9338 accessions relating to a wide range of history and science subjects. Over the years he accessioned 85 samples of amphibians and 75 samples of reptiles (Table 1).

Piers made the first record of the Atlantic Ridley in the coastal waters of Nova Scotia (Accession #3605). He incorrectly identified the turtle as "Loggerhead Turtle, *Thalassochelys caretta* (Linn.)". However, proper identification was easily made from the dried specimen and an excellent description, including a remarkably accurate line drawing by Piers (Figure 22).

Piers gave an excellent description of a Four-toed Salamander which was found in peat moss at Arthur Dean's Nursery in Halifax. Because this species had not been recorded previously from Nova Scotia he reasoned that this specimen was introduced into the province in a shipment of plants from the United States. However, J. Sherman Bleakney (1953) consulted the nursery records, which revealed that the peat moss, including the salamander, was gathered locally, therefore establishing this Four-toed Salamander as the first record for Nova Scotia.

Piers was the first to confirm that the "Jefferson's Salamander" (Blue-spotted Salamander) is native to Nova Scotia. He recorded three adult males from the Harmony-Camden area in Colchester County, which were captured in 1935 and preserved in the collections of the Provincial Museum. Piers recorded 18 measurements of the first specimen (Accession No. 8071) and prepared three line drawings (Figure 23) to accompany his detailed notes on the colour, number of costal grooves, number of vomerine teeth and body shape of the same specimen. He gave the second and third specimens (8102 and 8169) almost the same extended examination.

On April 13, 1896, at the sixth ordinary meeting of the Nova Scotian Institute of Science, Dr. A. H. MacKay presented a desiccated specimen of "*Diadophis punctatus* (L.), the Ringnecked or King Snake" (Northern Ringneck Snake) and discussed its habits, which he had observed for "a couple of months" while it was alive in captivity. Then he described the pursuit of a large "Green Frog, (*Rana clamata*)" by three large "Garter Snakes (*Eutania sirtalis*)" (Maritime Garter Snakes) near the Nictaux River in Annapolis County. MacKay then displayed a live adult "Newt, (*Diemyctylus viridescens*)" (Red-spotted Newt) which had been captured in a lake in Lunenburg County, and discussed the life history of that species.

MacKay also discussed the distribution of the amphibians and reptiles of the Atlantic Provinces and presented an updated list of species native to Nova Scotia. He pointed out that with the exception of the "Wood Tortoise" (Wood Turtle) specimens of each species on the list were preserved in the Pictou Academy. Unfortunately that institution, including the herpetological collections, was destroyed by fire. The following species were listed by MacKay: Yellow-spotted Salamander, Eastern Redback Salamander, "?(Blackish sp.)", Red-spotted Newt, Eastern American Toad, Tetraploid Gray Treefrog, Northern Spring Peeper, Northern Leopard Frog, Wood Frog, Green Frog, Bullfrog, Northern Redbelly Snake, Maritime Garter Snake, Eastern Smooth Green Snake, Northern Black Racer, Northern Ringneck Snake, Atlantic Leatherback, Common Snapping Turtle, Eastern Painted Turtle and Wood Turtle.

MacKay's "?(Blackish sp.)" may be the leadback phase of the Eastern Redback Salamander. Harry Piers, however, remarked when he recorded the

Table 1:
A list of species including the number of accessions and number of individuals of each species recorded by Harry Piers, former curator of the Provincial Museum

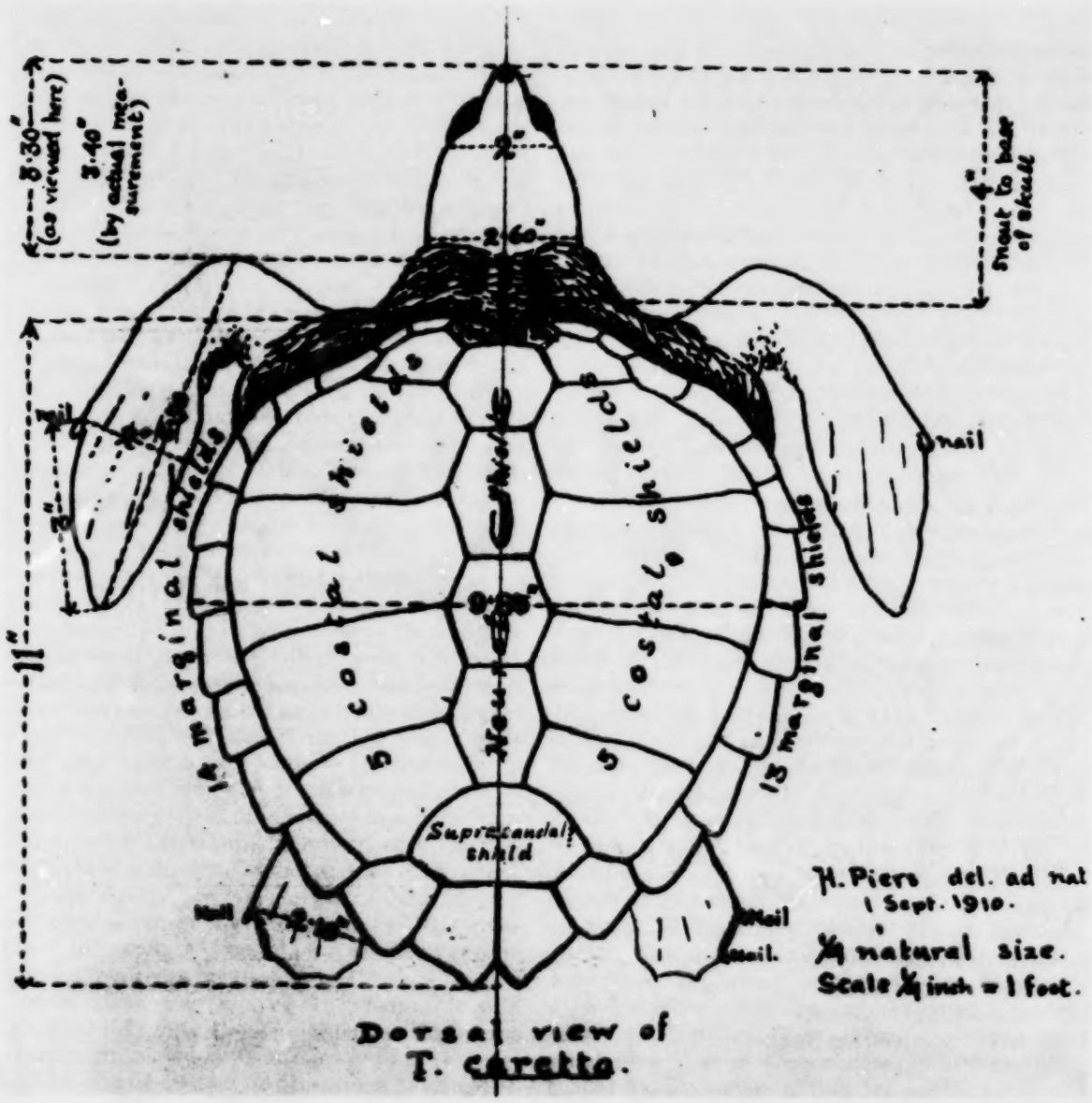
Species	No. of Accessions	No. of Specimens
Salamanders		
1. Blue-spotted Salamander	4	4
2. Yellow-spotted Salamander	23	23 and 1 egg mass
3. Red-spotted Newt	6	20
4. Eastern Redback Salamander	20	153
5. Four-toed Salamander	1	1
Frogs		
1. Eastern American Toad	5	4 and 16 tadpoles
2. Northern Spring Peeper	1	1
3. Bullfrog	5	5
4. Green Frog	5	5 and 17 tadpoles
5. Wood Frog	5	5
6. Pickerel Frog	6	6
7. Northern Leopard Frog	4	4
Turtles		
1. Common Snapping Turtle	3	3
2. Wood Turtle	5	5
3. Eastern Painted Turtle	3	3
4. Atlantic Ridley	3	3
5. Atlantic Leatherback	1	1
Snakes		
1. Northern Redbelly Snake	9	9
2. Maritime Garter Snake	34	32 and 2 shed skins
3. Northern Ringneck Snake	9	9
4. Eastern Smooth Green Snake	8	6 and 6 eggs
Total	160	344

first Nova Scotian specimen of the "Jefferson's Salamander" (Blue-spotted Salamander) that MacKay was no doubt referring to that species.

Alexander Howard MacKay made a remarkable contribution to natural history studies in Nova Scotia while he was Superintendent of Education for this province between 1891 and 1927. He organized teachers from all regions of Nova Scotia, who in turn instructed their students in observing and reporting on various annual phenomena of nature. The teachers recorded for their district the dates of the first leafing, flowering and fruiting of plants,

Figure 22.

A line drawing by Harry Piers of an Atlantic Ridley



including trees, as well as the first appearance of birds migrating north in spring and south in autumn, on phenological data sheets. Among other details recorded were the date of "the first piping frogs" (Northern Spring Peepers), and the "first appearance of snakes". The sheets were then forwarded to MacKay, who compiled them in volumes entitled "Phenological Observations, Nova Scotia". Volumes for the years 1897 to 1906 and 1908 to 1923 are in the Nova Scotia Museum Library.

In 1934, M. W. Smith conducted a survey of the flora and fauna of Lake Jesse, one of the headwater lakes in the Salmon River watershed, Yarmouth County. Smith published the results of his survey in the *Proceedings* of the Nova Scotian Institute of Science in 1936. His paper, entitled "A Survey of Lake Jesse, Nova Scotia" included notes on four species of amphibians in the fauna list. Smith's account of the amphibians is as follows:

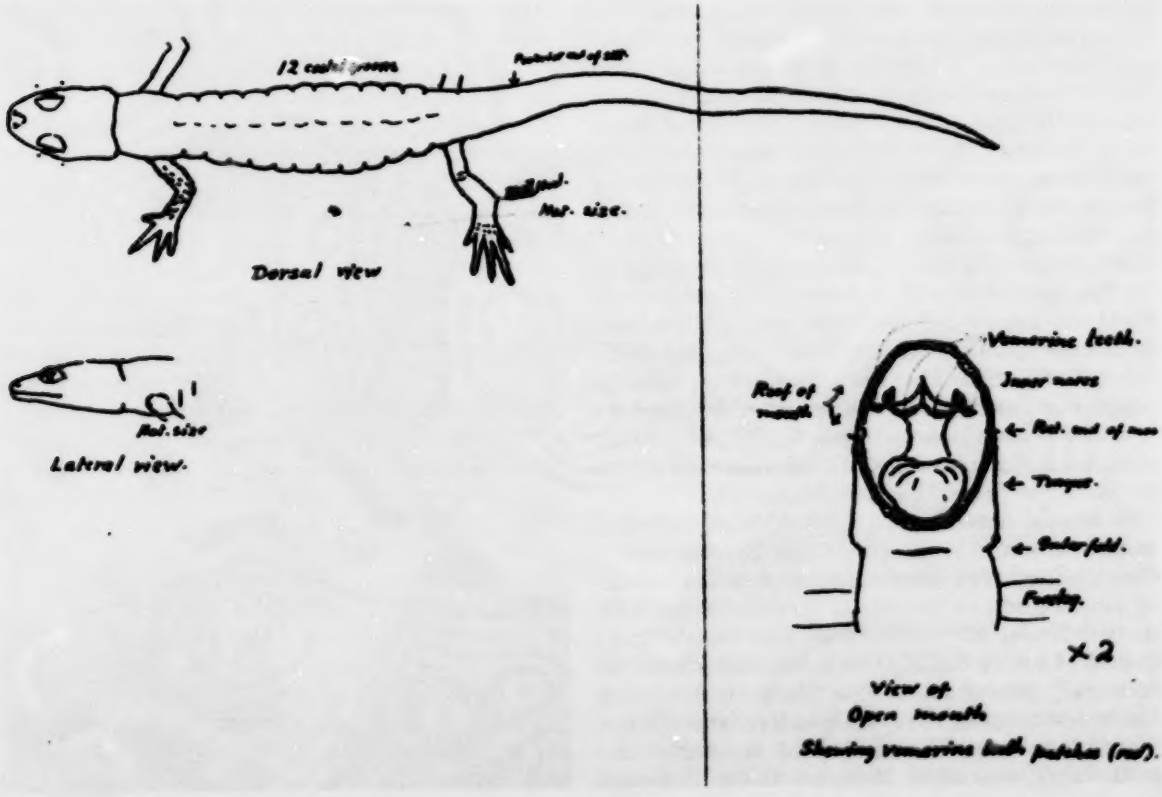
"9. Batrachia.

Triturus viridescens (Rafinesque) [Red-spotted Newt] was present in small numbers. A few *Rana clamitans* Latreille [Green Frog], and presumably its immature stages, were also found. *Rana palustris* Le Conte [Pickerel Frog] was noted at the outlet of the lake, and *Rana sylvatica* Le Conte [Wood Frog] was common in the adjacent woods."

In 1939 Clyde L. Patch published a paper entitled "Northern Records Of The Wood-Frog" in the herpetological notes section of the journal *Copeia*. His paper includes a table of average body, leg and foot measurements of Wood Frogs from various localities across Canada from Nova Scotia to the Yukon. He measured six specimens from four localities in Nova Scotia including Cape North, Cheticamp, Truro and Halifax. In his discussion he points out that Wood Frogs of southern Quebec,

Figure 23.

Three line drawings by Harry Piers of a Blue-spotted Salamander



southern Ontario, New Brunswick and Nova Scotia have longer legs than the short-legged Wood Frogs of northern Quebec, northern Ontario, Manitoba, Saskatchewan, Alberta, British Columbia and Yukon. He identified the eastern subspecies as *Rana s. sylvatica* and the western subspecies as *Rana s. cantabrigensis*. Subspecies status for Wood frogs is no longer recognized.

Over a period of four years R. Colin Mills gathered data on the amphibians and reptiles of Canada from herpetological collections in Canadian and American museums and, incorporating the locality data from his own collections, produced a paper entitled "A Check List of The Reptiles And Amphibians of Canada", a supplement published by *Herpetologica* in 1948.

Mills gave the scientific name, all of the common names known to him, and the range for each species of amphibian and reptile recorded for Canada. He said, "All records have been checked as far as possible and no reports without definite locations have been considered, except a few that are specifically mentioned in the text."

He included Nova Scotia in the range of the following amphibians and reptiles: Yellow-spotted Salamander, Eastern Redback Salamander, Eastern American Toad, Bullfrog, Green Frog, Wood Frog, Five-lined Skink, Northern Ringneck Snake, Eastern Smooth Green Snake, Northern Black Racer, Northern Redbelly Snake, Maritime Garter Snake, Common Snapping Turtle, Wood Turtle, Eastern Painted Turtle, Atlantic Leatherback, and Atlantic Loggerhead.

Mills did not include Nova Scotia in the range of the Red-spotted Newt, Northern Spring Peeper and Northern Leopard Frog, three amphibians previously listed by MacKay (1896) and reported on by Jones (1865). The Five-lined Skink and Atlantic Loggerhead are two reptiles not listed by Mac[illegible]y (1896) or reported on by Jones (1865). A breeding population of the Five-lined Skink does not exist in the Maritime Provinces (see Chapter VI).

In August, 1950 Gordon K. MacMillan collected amphibians and reptiles on Cape Breton Island. His collection of 81 specimens included three aquatic adults and one terrestrial juvenile of the Red-spotted Newt, 42 "red-backed" and three "dark-backed" Eastern Redback Salamanders, one adult Four-toed Salamander, four Eastern American Toads, one tadpole, 12 juvenile and six adult Green Frogs, four recently transformed Northern Leopard Frogs, one adult Northern Redbelly Snake and three Maritime Garter Snakes. The MacMillan collection and two Eastern Smooth Green Snakes collected by Paul L. Swanson on July 15, 1951 in Richmond County were deposited in the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania. They were reported on by Neil D. Richmond in a short but informative paper entitled "An Addition To The Herpetofauna of Nova Scotia, and Other Records of Amphibians and Reptiles on Cape Breton Island", published in the *Annals* of the Carnegie Museum in 1952. The main purpose of the paper was to publish the first record of the Four-toed Salamander.

While MacMillan was collecting molluscs and incidental samples of amphibians and reptiles on Cape Breton Island, John Sherman Bleakney (Figure 24) was collecting in selected areas throughout Nova Scotia. The purpose of his survey was to enlarge the herpetological collections at the Nova Scotia Museum of Science, the institution

Figure 24.

Portrait of J. Sherman Bleakney. Bleakney, former Curator of Amphibians, Reptiles and Fish, National Museum of Canada, Ottawa, was internationally recognized as an authority on Canadian herpetology

which financed the program, and to gather further information on amphibians and reptiles in Nova Scotia. The survey was organized and directed by Dr. D. J. McCallion, Biology Department, Acadia University, who was most interested in studying certain diseases of these animals. Bleakney produced a detailed study of his survey in a 126-page thesis entitled "The Distribution and Taxonomic Relationships of the Amphibians and Reptiles of Nova Scotia."

Bleakney mentioned in his introduction that he collected from April 19 to November 11, 1950, with some collecting being carried on through the winter months into March, 1951. He said, "All of the specimens collected were free of tumours. The amphibian specimens showed no evidence of Red-leg [a bacterial infection recognized by a red flush on the underside of the hind legs]. Many of the turtles were parasitized by leeches. A large number of grass frogs [Northern Leopard Frogs] had been mutilated, apparently by mowing machines."

During his field investigations Bleakney noted a decrease northward in the number of species within the province. He said, "The number of species of both amphibians and reptiles diminishes from south to north. The largest number of species is found in the southern central part of the province. In this region, both the number of species and population density of reptiles are greatest. Throughout the rest of the province large populations occur only in sheltered valley systems or in small ponds protected by a surrounding wall of forest."

In the closing paragraph of his introduction Bleakney said, "Of the species collected, eight are not recorded in R. C. Mill's (1948) 'Check List of Canadian Amphibians and Reptiles' as occurring in Nova Scotia."

Bleakney included a section on 'A History of Herpetological Studies in Nova Scotia' from 1865 to 1939. He begins by saying, "The present study of the amphibians and reptiles of Nova Scotia is the first organized investigation in the province. Although a few present-day naturalists are familiar with many of these animals, knowledge of them has been dependent on the writings of somewhat inaccurate observers of the nineteenth century."

He apparently was not aware of a collection of Nova Scotian amphibians and reptiles in the Royal Ontario Museum. He said, "Exclusive of the present collection available records total 93 specimens at the National Museum, Ottawa, (1910-1946) and 97 specimens at the Nova Scotia Museum of Science, Halifax (1899-1942). No distribution maps have ever been attempted on the basis of such a meagre collection. Detailed taxonomy, measurements, and sex ratios have had little attention. In fact, no records were found which had the specimen sexed."

Bleakney, however, had high regard for the records of Harry Piers. He said, "Most amphibian and reptile records made by Harry Piers give measurements and adequate descriptions of the date and place of collecting. Piers left some fine descriptions of snakes. He records the length, colour and pattern [Figure 25], and the number and appearance of the scales, leaving no doubt as to identification. Through such information, others may make comparisons."

He then reviewed the papers of previous workers. He said, "Because so few papers have been written pertaining to Nova Scotia herpetology, they are each of historical value. Reading through them from the earliest to the latest paper, the transition of the verbose and enthusiastic 'naturalist' to the precise and analytical 'scientist' can be traced."

In a section on "Field Procedures" Bleakney outlines his strategy for sampling the province. He explains his methods of collecting, taking field data on measuring, sexing and preserving the salamanders, frogs, turtles and snakes. An example of his data sheets is given in his Appendix I.

In a section on "The Collection" he said, "The collection contains approximately 2,400 records. Of these 795 are adult and immature amphibians (of 12 species); 1,550 (approximately) frog tadpoles and salamander larvae (of 9 species); and 31 groups of eggs (of 4 species). Adult and immature reptiles number 97 (of 8 species), and reptile eggs 14 (of 3 species)." In Appendix II he gives the total number of adults, tadpoles and eggs for each species of amphibian collected and the total number of adults for each species of reptile, including the number of eggs of three species.

Bleakney listed the eight species he found that were not recorded by Mills (1948) including three species which had never been recorded for Nova Scotia previously.

In his accounts he begins with the number of specimens collected. This is followed by a history of nomenclature in Nova Scotia, previous collections in the Nova Scotia Museum of Science and the National Museum of Canada. He includes information on "Distribution and Abundance", "Habitat

and Abundance", "Life History" and "Sex Determination" for each of the following species: Red-spotted Newt, Blue-spotted Salamander, Yellow-spotted Salamander, Eastern Redback Salamander, Eastern American Toad (including the Hudson Bay Toad), Northern Spring Peeper, Bullfrog, Green Frog, Pickerel Frog, Northern Leopard Frog, Mink Frog, Wood Frog, Northern Ringneck Snake, Northern Ribbon Snake, Maritime Garter Snake, Common Snapping Turtle, Wood Turtle and Eastern Painted Turtle.

In his discussion Bleakney explained that his samples consisted largely of adults because they were easier to find, sex and measure. He discussed the geology, flora and herpetofauna through a south to north transect of Kings County and grouped the amphibians and reptiles into three categories: those species which are unaffected by the changes of terrain, those species whose numbers are diminished by the clearing of land and by the presence of the dry, sandy areas of pine forest and those species which are benefited by the clearing of the land and the establishment of pastures and hayfields.

Bleakney then elaborates on the influence of man's activity on the herpetofauna. He compares his studies of the Nova Scotian herpetofauna with similar studies done in the United States and gives examples of geographical gradients in some species. He also includes a brief discussion concerning postglacial dispersal of the amphibians and reptiles of Nova Scotia.

Bleakney proposed nine herpetological sections for Nova Scotia. He said, "Their boundaries are, of course, not sharp but grade into one another. They are presented as a basis on which future workers may elaborate or criticize."

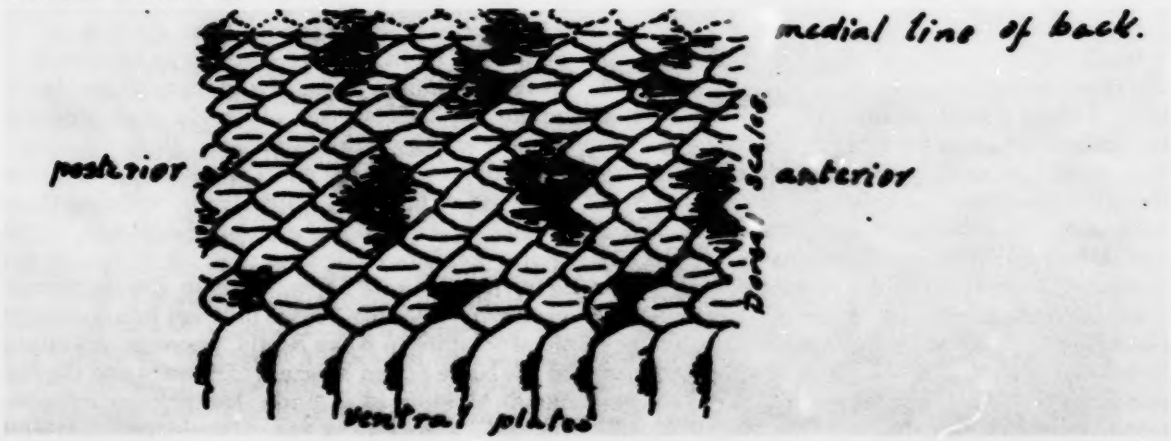
He listed 26 publications under "Literature Cited" and 11 additional references. He also provided eight photographs to illustrate various habitats and included a key to the adult amphibians and reptiles of Nova Scotia.

In a supplement Bleakney reported on three significant collections made during the week of April 9, 1951, in Queens County; he found further evidence that Northern Spring Peepers in Nova Scotia were large compared to the size given by Wright and Wright (1949); he found that the Blue-spotted Salamander was common in the Kempt area; and he collected an adult male Four-toed Salamander, the only specimen of that species obtained during his survey.

J. Sherman Bleakney became internationally recognized as an authority on Canadian herpetology as a result of his publications, 17 of which concern the herpetofauna of the Maritime Provinces. From 1952 to 1958 he was Curator of Amphibians, Reptiles and Fish at the National Museum of Canada, Ottawa. In 1956 he completed a Ph.D. program at McGill University, Montreal. His thesis, "A Zoogeographical Study of the Amphibians and Reptiles of Eastern Canada" is a major contribution to Canadian herpetology. It was published by the National Museum of Canada in 1958.

Figure 25.

A line drawing by Harry Piers of part of the trunk of a Maritime Garter Snake



Indigenous amphibians and reptiles

Although common or vernacular names have not been given to our fossil herpetofauna, a common name has been assigned to each of the amphibians and reptiles known to exist in Canada and the United States today. Most people, however, are not familiar with the common names selected by the scientific community. This can be a problem to the scientist because a local name for an animal often varies from one community to the next. For example, the Maritime Garter Snake is known to the Nova Scotian public as garter snake, green garter snake, garden snake, black snake, brown snake, diamond back snake, water snake and milk snake. Scientists therefore recommend that when a common name is used in communication or in publication it be accompanied by the designated scientific name. A scientific name is assigned to each species and although the name is subject to revision it is widely accepted and no two species can have the same name.

A scientific name consists of two words. The first word is a generic name (the first letter is capitalized), the second word is the specific name (the first letter is never capitalized). The author (the person who first described the animal) and the date it was described can be included. For example, ***Rana catesbeiana*** Shaw 1802 refers to the Bullfrog. ***Rana*** is the generic name, ***catesbeiana*** is the specific name, Shaw is the surname of the author and 1802 is the date he published the description of the Bullfrog.

When the author's name is in parentheses this means that the generic name has been changed since the animal was first described. For example, the original scientific name for the Blanding's Turtle was ***Cistudo blandingi*** Holbrook, but it is now ***Emydoidea blandingi*** (Holbrook).

Usually when an animal has an extensive geographical range regional differences are evident and some scientists divide the geographic variation into two or more subspecies, adding a third word for the subspecific name. For example, the Eastern Ribbon Snake, ***Thamnophis sauritus***, ranges from south-eastern Canada to Florida and has been separated into four subspecies. In the northern part of its range, which includes Nova Scotia, the species is represented by the Northern Ribbon Snake, ***Thamnophis sauritus septentrionalis***. Other members of the complex include the Southern Ribbon Snake, ***Thamnophis sauritus sauritus***, Peninsular Ribbon Snake, ***Thamnophis sauritus sackeni*** and Blue-striped Ribbon Snake, ***Thamnophis sauritus nitae***.

The task of naming animals is a sophisticated study called taxonomy and a person who engages in this work is called a taxonomist. Taxonomists are continually endeavouring to divide animals into the most appropriate categories, and changes in the common and scientific names are made known to the scientific community through publication.

When the standard common name is used, the first letter of each word should be capitalized. This is necessary in order to distinguish the Green Frog (***Rana clamitans melanota***) from other frogs of that colour. For example, Bullfrogs are green and are often referred to as green frogs by the public.

The common and scientific names used here have been adopted from the list presented by Cook (1981) in the ***Canadian Amphibian and Reptile Society Bulletin***. The common and scientific names used by most authors prior to 1981 may differ from those currently accepted, and are included in the systematic list.

Amphibia

Caudata

Ambystomatidae

Ambystoma laterale Hallowell

Ambystoma jeffersonianum (Green): Bleakney 1951
Ambystoma tremblayi Comeau: Gilhen 1974

Ambystoma maculatum (Shaw)

Salamandra subviolacea Harl.: Jones 1865
Amblystoma punctatum (L).: MacKay 1896

Salamandridae

Notophthalmus viridescens viridescens (Rafinesque)

Triton millepunctatus De Kay: Jones 1865
Diemyctylus viridescens: Piers 1892, MacKay 1896
Triturus viridescens viridescens Rafinesque: Bleakney 1951

Plethodontidae

Plethodon cinereus (Green)

Plethodon erythronotus Baird: Storer 1851, Verrill 1863

Salamandra erythonota Holb.: Jones 1865
Plethodon erythronotus (Green): MacKay 1896
Plethodon cinereus cinereus (Green): Mills 1948, Bleakney 1951

Amphibians

Salamanders

Mole Salamanders

Blue-spotted Salamander

Jefferson's Salamander: Bleakney 1951
Tremblay's Salamander: Gilhen 1974

Yellow-spotted Salamander

Violet-coloured Salamander: Jones 1865
Spotted Salamander: Mills 1948, Bleakney 1951

Newts

Red-spotted Newt

Dr. Gilpin's Red-bellied Salamander: Jones 1865
Crimson Spotted Triton: Jones 1865
Red Eft: MacKay 1896
Vermillion-spotted Olive-back Newt: MacKay 1896
Spotted Newt: Bleakney 1951

Lungless Salamanders

Eastern Redback Salamander

Red-backed Salamander: Verrill 1863, Jones 1865, MacKay 1896, Mills 1948, Bleakney 1951

?(Blackish sp.): MacKay 1896

Lead-backed Salamander: Mills 1948

Hemidactylium scutatum (Schlegel)	Four-toed Salamander

Anura

Frogs

Bufonidae

Toads

Bufo americanus americanus Holbrook

Eastern American Toad

Bufo americanus Le Conte: Storer 1851, Verrill 1863, Hardy 1869
Bufo Americanus Harlen: Jones 1865
Bufo lentiginosus (Shaw): MacKay 1896
Bufo terrestris americanus Holbrook: Bleakney 1951

Common Toad: Verrill 1863, Hardy 1869
Toad: Ambrose 1868
American Toad: Jones 1865, MacKay 1896, Mills 1948
Hop Toad: Mills 1948
Common American Toad: Bleakney 1951

Hylidae

Treefrogs

Hyla crucifer crucifer Wied

Northern Spring Peeper

Hylodes pickeringii Holb.: Jones 1865, Hardy 1869, MacKay 1896
Hyla pickeringii (Holbrook): MacKay 1896

Pickerings Hylodes: Jones 1865
Little Hylodes: Hardy 1869
Pickerings Tree Toad: MacKay 1896
Spring Peeper: Bleakney 1951

Ranidae

Typical Frogs

Rana catesbeiana Shaw

Bullfrog

Rana pipiens Harl.: Jones 1865

American Bullfrog: Mills 1948
Jug o' Rum: Mills 1948
Bloody Nouns: Mills 1948

Rana clamitans melanota (Rafinesque)

Green Frog

Rana fontinalis Le Conte: Storer 1851, Hardy 1869
Rana clamata (Daudin): MacKay 1896
Rana clamitans Latreille: Smith 1936, Mills 1948, Bleakney 1951

Spring Frog: Jones 1865, Mills 1948, Bleakney 1951

Rana septentrionalis Baird	Mink Frog
	Northern Frog: Bleakney 1951
Rana sylvatica Le Conte	Wood Frog
***Rana sylvatica sylvatica* Le Conte: Mills 1948, Bleakney 1951**	
Rana pipiens Schreber	Northern Leopard Frog
***Rana halecina* Kalm.: Storer 1851, Verrill 1863, Jone 1865**	**Leopard Frog: Verrill 1863, Jones 1865, MacKay 1896, Bleakney 1951** **Grass frog: Bleakney 1951**
Rana palustris Le Conte	Pickerel Frog

Reptila

Testudines

Chelydridae

Chelydra serpentina serpentina (Linnaeus)	Common Snapping Turtle
***Chelonura serpentina*, De Kay: Jones 1865** ***Chelydra serpentina* (L.): MacKay 1896**	**Snapping Turtle: Jones 1865, MacKay 1896, Mills 1948, Bleakney 1951**

Emydidae

Clemmys insculpta (Le Conte)	Wood Turtle
***Emys insculpta* De Kay: Jones 1865** ***Chelopus insculptus* (Le Conte): MacKay 1896**	**Wood Terrapin: Jones 1865** **Wood Tortoise: MacKay 1896**
Emydoidea blandingi (Holbrook)	Blanding's Turtle

Reptiles

Turtles

Snapping Turtles

Semiaquatic, Pond and Marsh Turtles

Chrysemys picta picta (Schneider)	Eastern Painted Turtle
Emys picta De Kay: Jones 1865 ***Chrysemys picta*** (Hermann): MacKay 1896	Painted Tortoise: Jones 1865
Cheloniidae	**Marine Turtles**
Lepidochelys kempi (Garman)	Atlantic Ridley
Caretta caretta caretta (Linnaeus)	Atlantic Loggerhead
	Loggerhead Turtle: Mills 1948
Dermochelyidae	**Leatherback Turtles**
Dermochelys coriacea coriacea (Linnaeus)	Atlantic Leatherback
Sphargis coriacea: Piers 1890 ***Dermochelys coriacea*** (Vandelli): MacKay 1896, Piers 1897	Leather Turtle: Piers 1890 and 1897 Trunk-back: Piers 1897 Leatherback Turtle: Mills 1948
Squamata	**Lizards and Snakes**
Serpentes	**Snakes**
Colubridae	**Typical Snakes**
Storeria occipitomaculata occipitomaculata (Storer)	Northern Redbelly Snake
Coluber occipitao-maculatus Storer: Jones 1865 ***Storeria occipitomaculata*** B. & G.: Gilpin 1875 ***Storeria occipitomaculata*** Storer: MacKay 1896, Bleakney 1951	Spotted-neck Snake: Jones 1865 Red-bellied Snake: Gilpin 1875, MacKay 1896, Mills 1948, Bleakney 1951 Copper Belly: Mills 1948
Thamnophis sauritus septentrionalis Rossman	Northern Ribbon Snake
Thamnophis sauritus sauritus Linnaeus: Bleakney 1951	Ribbon Snake: Bleakney 1951

Thamnophis sirtalis pallidula
Allen

Maritime Garter Snake

Tropidonotus distalis **Holb.: Storer 1851**
Coluber sirtalis **— Linn.: Jones 1865, Gilpin 1875**
Eutonia sirtalis **B. & G.: Gilpin 1875, MacKay 1896**
Thamnophis sirtalis sirtalis **Linnaeus: Mills 1948, Bleakney 1951**

Spotted Snake: Jones 1865

Common Striped Snake: Jones 1865
Garter Snake: Gilpin 1875, Mills 1948
Common Garter Snake: MacKay 1896, Mills 1948, Bleakney 1951
Striped Snake: Mills 1948
Grass Snake: Mills 1948
Common Snake: Mills 1948

Diadophis punctatus edwardsi
(Merrem)

Northern Ringneck Snake

Coluber punctatus **— Linn: Jones 1865**
Diadophis punctatus **B. & G.: Gilpin 1875**
Diadophis punctatus: **Piers 1892 and 1897**
Diadophis punctatus **(L): MacKay 1896**

Ringneck Snake: Jones 1865, MacKay 1896
King Snake: Gilpin 1875

Ring Snake: Piers 1892 and 1897
Ring-neck Snake: Mills 1948

Opheodrys vernalis vernalis
Harlan

Eastern Smooth Green Snake

Chlorosoma vernale **B. & G.: Verrill 1863**
Liopeltis vernalis **Cope: Verrill 1863**
Coluber vernalis **— DeKay: Jones 1865**
Liopeltis vernalis **(DeKay): MacKay 1896**

Green Snake: Verrill 1863, Jones 1865, Gilpin 1875
Grass Snake: MacKay 1896, Mills 1948
Smooth Green Snake: Mills 1948, Bleakney 1951

Rejections from the herpetofauna of Nova Scotia

Northern Spring Salamander

Gyrinophilus porphyriticus porphyriticus (Green)

Jones (1865) included an account of "Dr. Gilpin's *Red-bellied Salamander*". He said, "Dr. Gilpin informs me there is yet another salamander, having the underparts red. This may be the Salmon-coloured Salamander (*S.salmonea*) which has its sides salmon-coloured. It is known in Massachusetts, and may therefore occur in this Province."

The only salamander native to Nova Scotia which is red on the underside is the red-eft, the terrestrial juvenile stage of the Red-spotted Newt. The Salmon-coloured Salamander, presently called the Northern Spring Salamander, is not known to occur in the Maritime Provinces.

Hudson Bay Toad

Bufo americanus copei Yarrow and Henshaw

Bleakney (1951) recognized a difference between the ventral markings of the toads inhabiting the Wolfville and Kentville region of the Annapolis Valley and those of the remainder of the province. He said, "It was noticed that most of the toads collected beyond the limits of the Annapolis Valley (in the region of Wolfville and Kentville) possessed heavily pigmented ventrums. The group found in the Valley has the majority of the ventral spots in the pectoral region. The other group, found in parts of the Valley and over the rest of Nova Scotia, has the ventral spots enlarged and often joined together forming a black reticulation, and these pigment areas are in both pectoral and pelvic regions. This is one of the characters used by Wright and Wright to distinguish *B.t.americanus* (Eastern American Toad) from the dark-bellied subspecies *B.t.copei* (Hudson Bay Toad)." Bleakney also found a difference in the ratio of the body length to foot length.

Bleakney (1958), however, no longer recognized the Hudson Bay Toad as a distinct subspecies. He used the nomenclature of K. P. Schmidt, "A Check List of North American Amphibians and Reptiles" (1953) but took exception to his treatment of the Common Toad. Bleakney reduced *Bufo terrestris americanus* (Eastern American Toad) and *B.t. copei* (Hudson Bay Toad) to *B.americanus* (American Toad). Cook (1981) does not recognize the Hudson Bay Toad as distinct from the Eastern American Toad (based on Cook's 1978 unpublished Ph.D. thesis, University of Manitoba).

Squirrel Treefrog

Hyla squirella Bosc.

John Matthew Jones (1868) reported this species from Nova Scotia. Jones said, "Through the assi-

duity of Mr. Arthur Silver, I am now enabled to add another species to the list, viz. the Squirrel Tree Frog, or Little Peeping Hyla (*Hyla squirella*)." Jones makes some general statements concerning the external characteristics of treefrogs but gives no description of the specimen from Nova Scotia. He discusses the distribution of the Squirrel Treefrog but gives no locality where it had been taken in Nova Scotia.

There is no evidence of Squirrel Treefrogs in Canada. This species is native to southeast Virginia to the Florida Keys, west to Louisiana and along the coast of Texas to Corpus Christi Bay. There are isolated colonies in Alabama, Mississippi and Oklahoma. The Squirrel Treefrog was not included in the Nova Scotia herpetofauna lists of subsequent authors.

Tetraploid Gray Treefrog

Hyla versicolor LeConte

This treefrog was first reported in Nova Scotia by J. M. Jones (1865), who stated, "I am enabled to add this species to the list of Nova Scotian reptiles, through the kindness of Capt. Hardy, R. A., who informs me that although he has never been fortunate enough to secure a specimen, yet from the description given him by a young Indian who collects for him, he has not the slightest doubt as to the species. His informant states that he has found it snugly ensconced in clefts of maple trees, where, from its gray colour harmonizing with the lichens growing on the bark of the tree, it was difficult to observe. Capt. Hardy tells me that the pipe of this tree toad is similar to that of Pickering's Hylodes [Northern Spring Peeper], although much louder, and that it is more vociferous during damp foggy weather."

MacKay (1896) included this species in his list of Nova Scotian amphibians and reptiles. Bleakney (1951), however, questioned Jones' (1865) report and later (Bleakney, 1958) reported, "I have searched diligently for this species in the province but without success."

I have also found no evidence of a breeding population of the Tetraploid Gray Treefrog in Nova Scotia. Its mating call is distinct from that of the Northern Spring Peeper. The Northern Spring Peeper in Nova Scotia is variable in colour and pattern. Possibly, large gray individuals with an indistinct pattern on the back have been mistaken for the Tetraploid Gray Treefrog.

Five-lined Skink

Eumeces fasciatus (Linnaeus)

Mills (1948) included Nova Scotia in the range of the Five-lined Skink. Bleakney (1951) did not find this species during his 1950 survey and he does not include Quebec and the Maritime Provinces in his 1958 range map for the species.

The Five-lined Skink is native to southern Ontario in Canada and from New England to northern Florida, west to Wisconsin and eastern parts of Kansas, Oklahoma and Texas.

Northern Black Racer

Coluber constrictor constrictor Linnaeus

The Northern Black Racer was first reported for Nova Scotia by Jones in 1865. He does not give a description of this snake. Jones said, "Although this species is very rare in the neighbourhood of Halifax, I imagine it is common in the interior of the colony, from information I have received."

Gilpin (1875) gives an account of this species in his paper on Nova Scotia snakes. He said, "This snake is exceedingly rare in our Province, and I am indebted to Mr. J. M. Jones, F.L.S., for the only adult specimen I have identified. Mr. Downs had recognized it, and the various stories of large

snakes from many sources could only have been referred to it. Mr. Jones' specimen was of moderate size, and agreed perfectly with the description of Buird & Girard, (Smithsonian Inst.) in its dark shining black above, bluish black below, and white about the chin and breast. Of its habits or haunts, I have no notes or observations, as in our Province." The description given by Gilpin also fits a melanistic Maritime Garter Snake. He does not record whether the dorsal scales are smooth as in the racers or keeled as in the garter snakes.

Piers (1890) also gives an account of the Northern Black Racer in Nova Scotia. Unfortunately the account is based on a recollection of a happening at least three years previous to his paper. He said, "Three or four summers ago I captured a Black Snake as it was crossing a grassy road to the east of Blockhouse (Stanford's) Pond, near the Three-mile House. It was a couple of feet in length and answered perfectly the description of this species." As curator of the Provincial Museum, about 39 years following that report, Piers gave a detailed description of a black (melanistic) Maritime Garter Snake (accession No. 6519). Preceding the description he said, "From its colour it would be mistaken for a Black Snake (Northern Black Racer)."

MacKay (1896) and Mills (1948) include the Northern Black Racer in their list of Nova Scotia reptiles.

Bleakney (1951) did not find this snake during his 1950 survey. He said, "It is quite possible that the black snake (*Coluber constrictor*) does occur in Nova Scotia and by means of snake traps it might be possible to capture a specimen." Bleakney (1958) included the "Black Racer" in his "Phylogenetic List" of species for Eastern Canada. However, under a section on "Rare or Questionable Reports" he said, "There is one species that deserves special mention, and it involves New Brunswick, Prince Edward Island, and Nova Scotia. It is *Coluber c. constrictor* (Northern Black Racer), a glossy black snake that reaches 4 to 5 feet in length. There is no other maritime snake that could be confused with it . . . I myself have heard black snake stories in Nova Scotia, Prince Edward Island and New Brunswick, yet there is not a specimen in existence that can be credited to Canada. There is, however, one adult specimen in the Nova Scotia Museum of Science which was found by Piers in an unlabelled bottle among the Museum's collections. The history of this specimen is an enigma."

Cook (1967) was the first to formally reject this species from the herpetofauna of the Maritime Provinces. He said, "Although Bleakney accepted the scattered published observations and verbal reports of *Coluber c. constrictor* in the Maritimes, further efforts to obtain specimens have failed. As discussed under "Rejected Records", evidence for its occurrence is inconclusive, and it should be deleted from the Maritime herpetofauna."

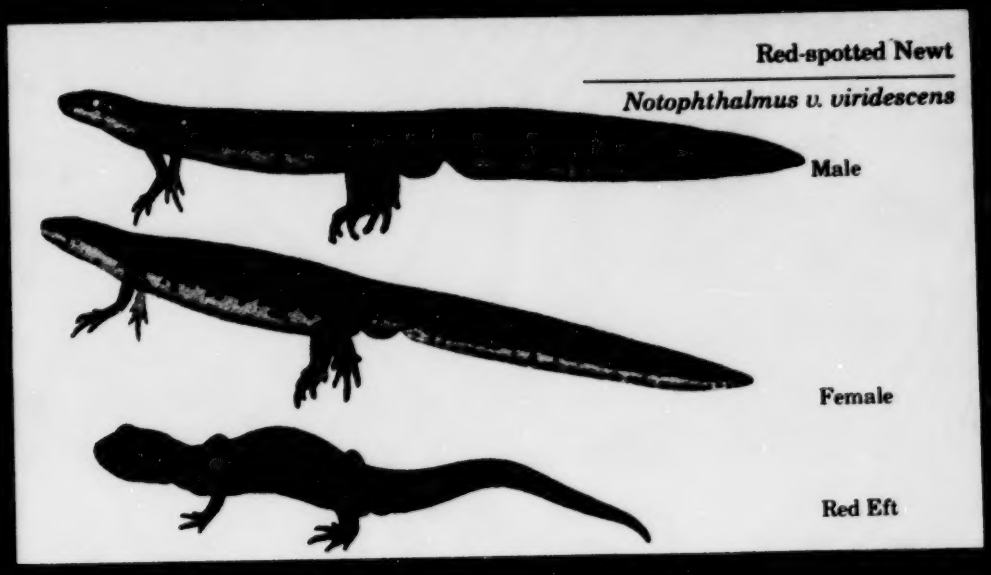
This species is found in the United States from southern Maine to central Alabama.

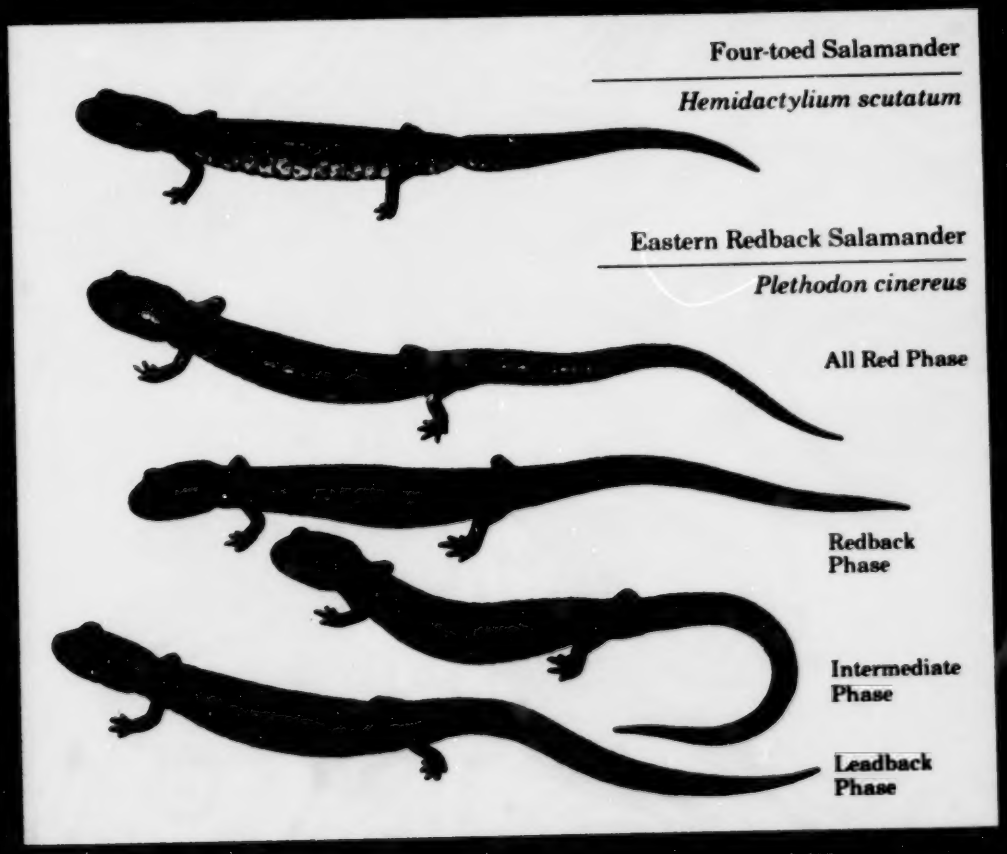
Blue-spotted Salamander

Ambystoma laterale

Yellow-spotted Salamander

Ambystoma maculatum


Red-spotted Newt
Notophthalmus v. viridescens
Male
Female
Red Eft

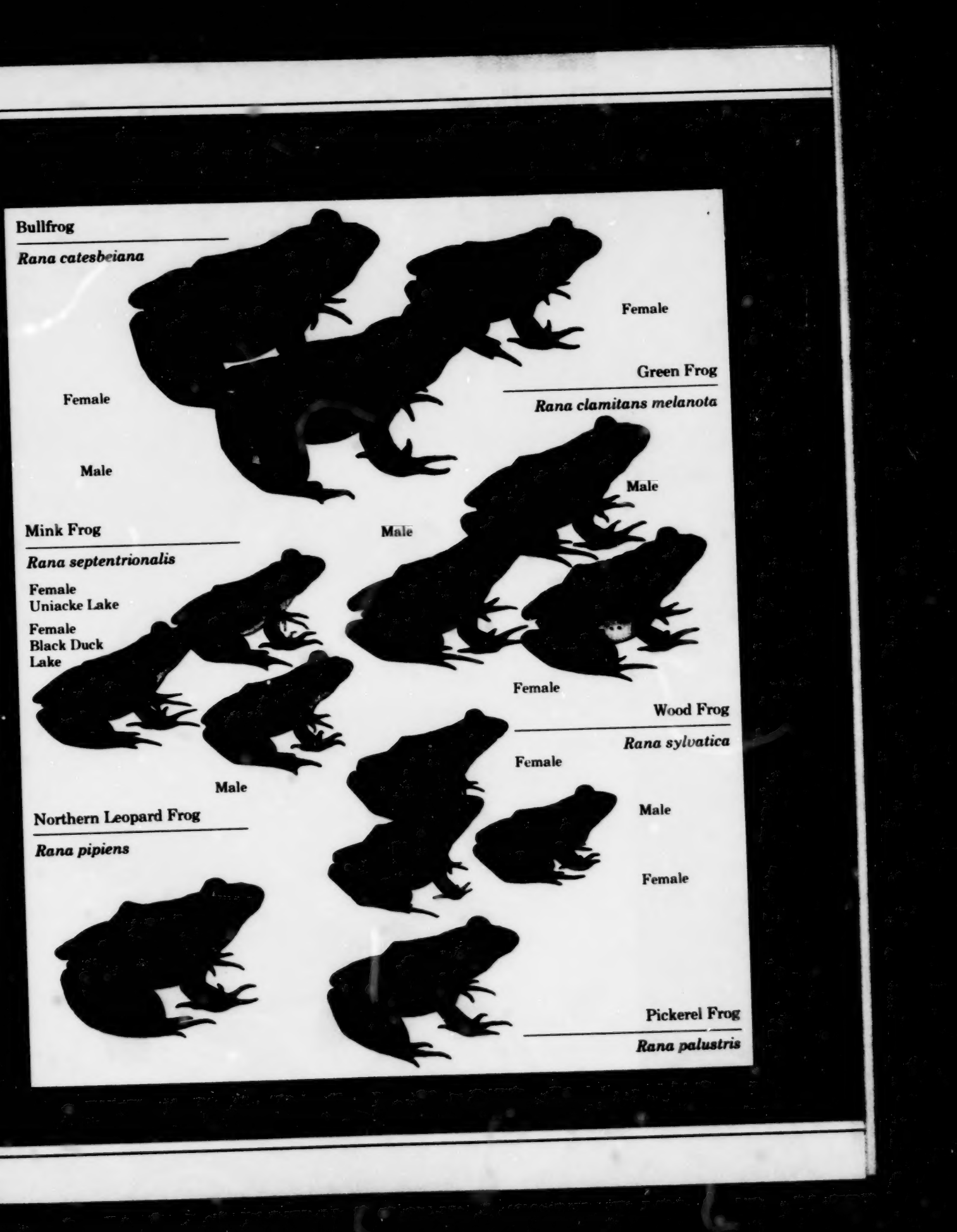

Four-toed Salamander
Hemidactylium scutatum
Eastern Redback Salamander
Plethodon cinereus
All Red Phase
Redback Phase
Intermediate Phase
Leadback Phase

Eastern American Toad

Bufo a. americanus

Northern Spring Peeper

Hyla c. crucifer


Bullfrog
Rana catesbeiana
Female
Female
Male
Green Frog
Rana clamitans melanota
Male
Male
Mink Frog
Rana septentrionalis
Female
Uniacke Lake
Female
Black Duck
Lake
Male
Female
Wood Frog
Rana sylvatica
Female
Male
Female
Northern Leopard Frog
Rana pipiens
Pickerel Frog
Rana palustris

Turtles

Common Snapping Turtle

Chelydra s. serpentina

Wood Turtle

Clemmys insculpta

Blanding's Turtle

Emydoidea blandingi

Eastern Painted Turtle

Chrysemys p. picta

Atlantic Ridley

Lepidochelys kempi

Atlantic Loggerhead

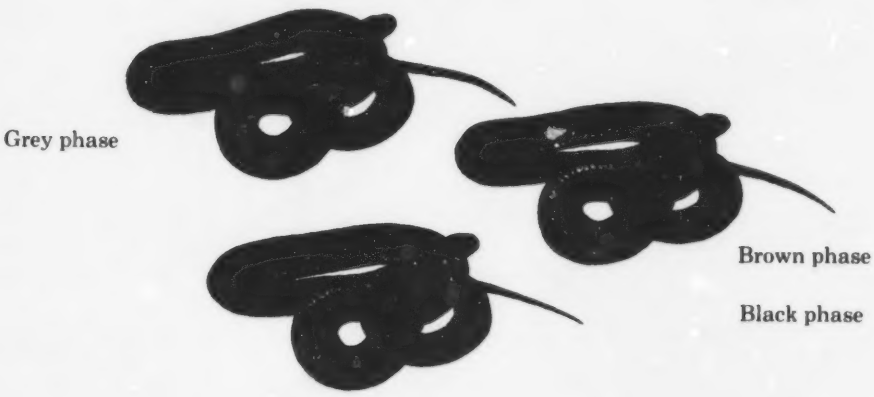
Caretta c. caretta

Atlantic Leatherback

Dermochelys c. coriacea

Northern Redbelly Snake

Storeria o. occipitomaculata



Northern Ribbon Snake

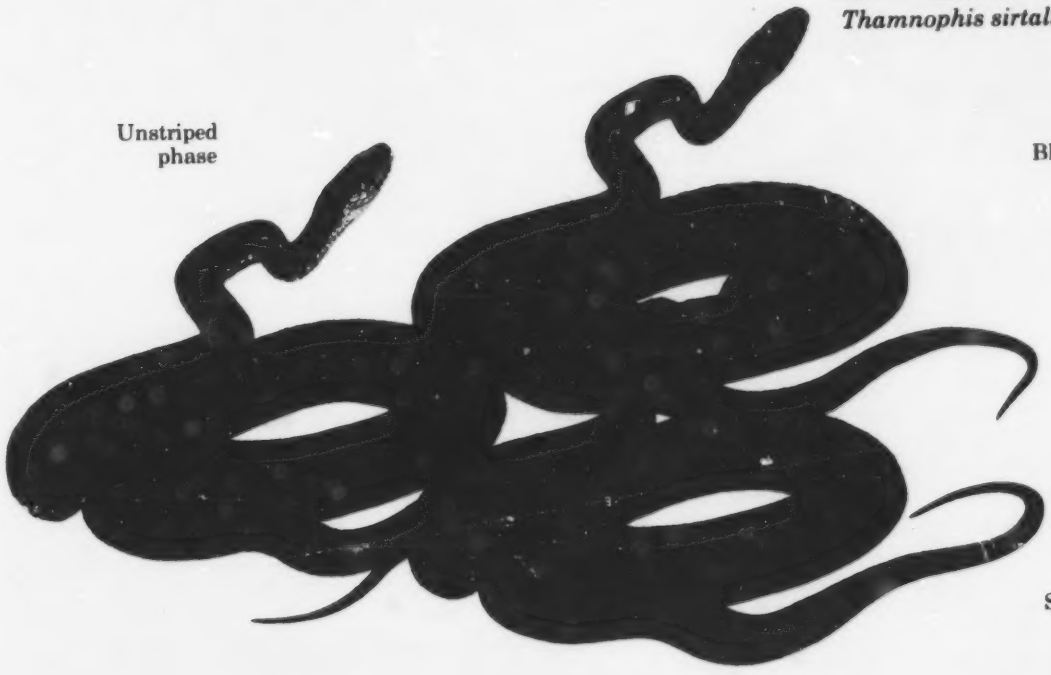
Thamnophis sauritis septentrionalis

Maritime Garter Snake

Thamnophis sirtalis pallidula

Unstriped phase

Black phase



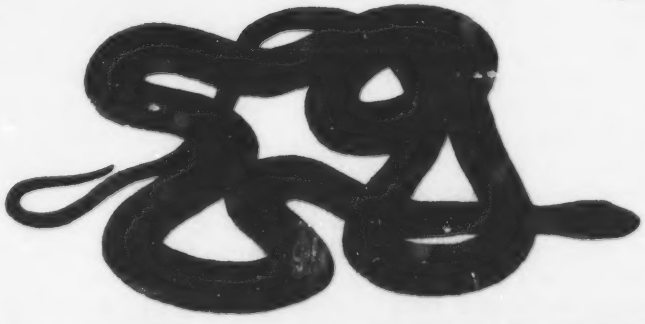
Striped phase

Northern Ringneck Snake

Diadophis punctatus edwardsi

Eastern Smooth Green Snake

Opheodrys v. vernalis



Salamanders

Order: Caudata

The term caudata means tailed. Unlike frogs, salamanders retain their tails, throughout life. The term salamander is derived from the Greek word 'salamandra' meaning lizard-like animal. Eight families of salamanders have been recognized, comprising about 336 species currently known to science. Three families, the mole salamanders (Ambystomatidae), the newts (Salamandridae) and the lungless salamanders (Plethodontidae) are represented in Nova Scotia.

With the exception of two families, the hellbenders (Cryptobranchidae), which are large aquatic salamanders of North America and Asia, and a closely related terrestrial family (Hynobiidae), found only in Asia, fertilization of eggs is internal. The male goes through a courtship display, which varies from one species to the next, and then deposits a small gelatinous sperm-capsule, called a spermatophore, in the general area of the female. The female, excited by the behaviour of the male, positions her body over the capsule and, with the lips of her cloaca, lifts it up and stores it in a special receptacle, called a spermatheca, until she is ready to lay her eggs. The eggs are fertilized as they pass through the cloaca of the female.

In contrast to frog tadpoles, salamander larvae are slender and elongate with a flat or compressed head. Also, unlike frog tadpoles, salamander larvae have external gills throughout the larval stage, and the front legs are visible first.

Salamanders depend a great deal on their senses of sight and smell to locate food, find a mate during the breeding season and avoid predators. Although some species, notably the mudpuppy (Proteidae), are known to make gulping sounds, most salamanders are essentially voiceless. They do not hear audible sounds but their ability to feel vibrations from the ground with their forelimbs or lower jaw and to relay this information to the brain is considered to be a primitive sense of hearing.

Salamanders generally live secluded from humans. However, Blue-spotted Salamanders and Yellow-spotted Salamanders occasionally work their way into basements, particularly in rural areas if the soil floor is cool and damp. In urban areas Eastern Redback Salamanders are often observed when rocks are turned over in gardens.

Because of their secretive living habits few observations have been recorded on salamander predation. On April 25, 1971, at 2105 hours in a roadside cattail pond at Urbania, Hants County, two caddisfly larvae were observed penetrating the egg mass of a Yellow-spotted Salamander and feeding on the developing larvae. On July 31, 1969, at 1320 hrs, in the Thompson Station area, Cumberland County, four green carabid beetles, *Chlaenius sericeus*, were observed feeding on two Blue-spotted Salamanders, newly transformed from the larval stage, when a large piece of wet cardboard was turned over at the margin of a roadside cattail pond. Two of the beetles were feeding in the gular region of a freshly-killed salamander, while the other two were successfully holding and feeding on the gill buds of the second salamander, which was alive but in weak condition. These green carabid beetles are seen occasionally on roads during rainy nights feeding on amphibians killed by automobiles.

Added to these specific cases are records of predation discovered while examining the stomach contents of preserved specimens. A female Red-spotted Newt collected in a roadside pond near John Smith Brook, Cumberland County, April 30, 1977, had eaten a Blue-spotted Salamander egg. A juvenile Northern Ribbon Snake collected at Cranberry Cove, Molega Lake, Lunenburg County, September 6, 1976, had eaten a Red-spotted Newt larva. The Eastern Redback Salamander is an important food item of Northern Ringneck Snakes and juvenile Maritime Garter Snakes. I was in-

formed on two occasions by anglers that they had found a Yellow-spotted Salamander in the stomach of a Brook Char (Brook Trout), *Salvelinus fontinalis*.

In aquariums set up with pond life, large predacious diving beetles (*Dytiscus verticalis*) and their aggressive larvae, called water tigers, have been observed feeding on Yellow-spotted Salamander larvae.

No doubt salamanders fall prey to a number of other predators. Future observations may reveal that some birds and mammals will feed on salamanders when they have the opportunity to do so.

The ability of salamanders to regenerate severed limbs or tail has been a matter of interest to scientists for many years. The tail is the usual appendage severed accidentally or by predators. Many mole salamanders are run over by automobiles as they migrate across roads to breeding ponds. If only the tail or a limb has been severed, the salamander may continue the journey and perhaps return again the following year with the wound healed and the appendage in the process of regeneration.

When a snake grasps an Eastern Redback Salamander by the tail, this salamander squirms vigorously, sheds its tail at the point where it is being held and may escape while the snake is busy swallowing the tail. In some cases the tail is the only part of an Eastern Redback Salamander found in the stomach of preserved Northern Ringneck Snakes, and Eastern Redback Salamanders with a regenerated tail are common in preserved collections of this species. The ability of this salamander to shed its tail, therefore, is beneficial to the species while still providing some nourishment for the predator.

The Four-toed Salamander has a double constriction near the base of the tail and most individuals will shed the tail at this delicate part if care is not taken during handling.

Since the tail of some salamanders is in a state of regeneration, herpetologists carefully examine the tail of each specimen before it is measured. The regenerated part never is as long as the normal length had the tail not been severed, but the older the wound the more difficult it is to determine the point of breakage and decide whether the tail had ever been broken off. It is important to note the condition of the tail because only by excluding individuals whose tails are in a state of regeneration can an accurate tail length and total length range for a particular species be made.

The three basic measurements of a salamander are the body length (snout to posterior angle of the vent), tail length (posterior angle of the vent to the tip of the tail) and total length (snout to the tip of the tail) (Figure 26). Some herpetologists have published measurements of the body length taken from snout to mid-vent. If both body length measurements are taken, then this measurement can be computed for comparison. Other length measurements which have been taken are head length (snout to posterior edge of the gular fold) and interlimb length (Figure 26).

Colour notes are important and when detailed notes are required they should be made from living specimens, shortly after capture. General colour notes can be made from specimens before they are fixed in a preservative. For example, the different colour phases in a series of Eastern Redback Salamanders should be noted for each locality.

The number of red spots on the Red-spotted Newt and the number of yellow spots on the Yellow-spotted Salamander are counted. The total number can be expressed first as a fraction, giving the number on the left side over the number on the right side, followed by an equal sign and the total number. Since there are yellow spots on the head, trunk and tail of the Yellow-spotted Salamander, a hypothetical individual having a total of 29 yellow spots could have the following spot counts: head $^{1}/_{2} = 5$, trunk $^{8}/_{7} = 15$; tail $^{1}/_{4} = 9$ and a total count of $^{16}/_{13} = 29$.

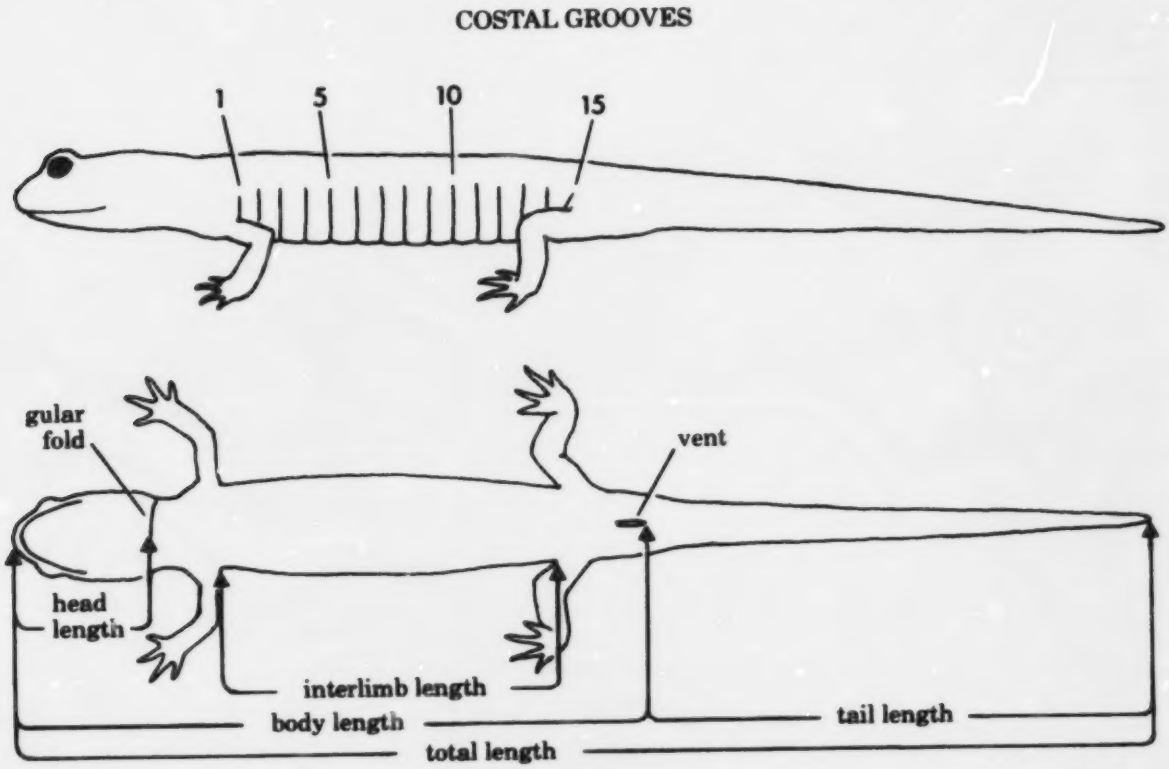
When counting these spots, the division between the trunk and tail depends upon the method used in measuring body length. Cook (1967) measured the body length of Prince Edward Island specimens from snout to mid-vent and used the costal groove directly over the hind limb as the division between trunk and tail. I measure the body length from snout to posterior angle of the vent and use the groove directly above the posterior angle of the vent as the division between the trunk and tail. For comparative purposes both methods should be employed. When two or more spots are fused together they are counted as one spot. The yellow spots on the limbs should also be counted.

Herpetologists examine salamanders for a number of other external characters. The deep vertical grooves along the sides of the body, called costal grooves, are counted (Figure 26). Studies by Richard Highton (1957) have shown that each costal groove indicates the position of a rib and there-

fore the number of trunk vertebrae can be estimated without preparing skeletons or taking radiographs.

Figure 26.

External characteristics and methods of measuring salamanders



Mole Salamanders

Family Ambystomatidae

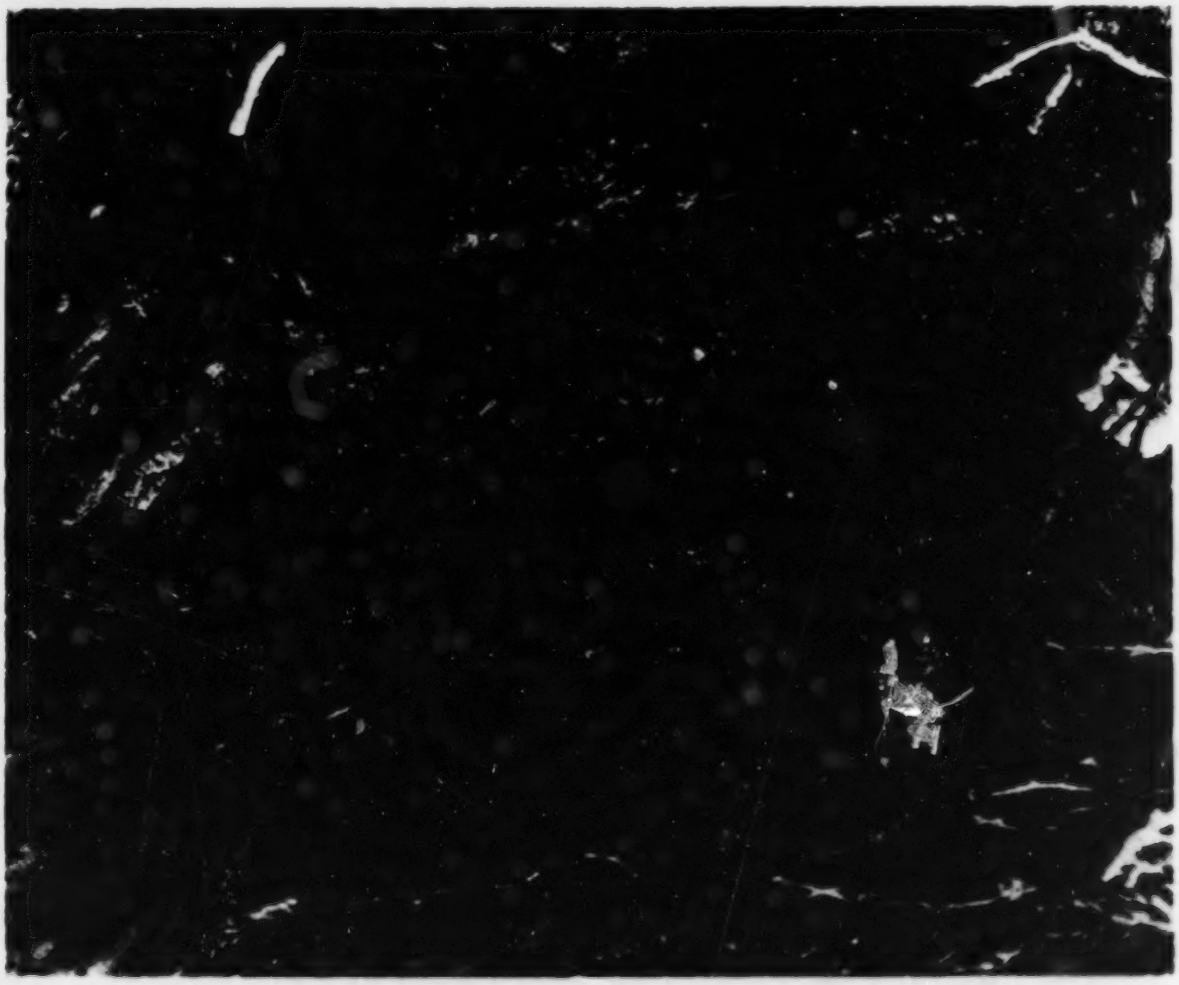
These thick-bodied salamanders burrow through the loose humus of the forest floor and make use of the tunnels made by other animals (Figure 27). It is this behaviour which has earned them the family name of mole salamanders.

This family of North American salamanders is divided into four genera and 33 species. Two species, the Blue-spotted Salamander and the Yellow-spotted Salamander of the genus *Ambystoma*, represent the family in the Maritime Provinces.

All members of the mole salamander family have four toes on the front feet and five toes on the hind feet. The larvae are carnivorous.

Figure 27.

Tracks of Yellow-spotted Salamander on wet, firm mud on woods road leading to Placides Lake, Digby County, on April 25, 1979



The Jefferson's Salamander Complex

In eastern North America there are two similar species of blue-spotted mole salamanders, which for many years were confused as one species, the Jefferson's Salamander, *Ambystoma jeffersonianum*. Uzzell (1964) completed a major study of this complex. He suggested that both species were from the same ancestral stock but during the Wisconsin Glaciation they became separated into two major populations. When the ice receded, exposing the vast area of land and fresh water between the two populations, they gradually recolonized it and eventually came in contact with each other in New York and New England. However, during the thousands of years of isolation they differentiated into two species. Uzzell recognized a southern species having a broader snout, longer legs, greater body size, lighter colour and fewer spots than the northern species. The name Jefferson's Salamander, *A. jeffersonianum*, was retained for the southern species and the name Blue-spotted Salamander, *A. laterale*, was accepted for the northern species.

During Uzzell's study of the Jefferson's Salamander complex he became aware of an unusual phenomenon of nature. The Jefferson's Salamander and the Blue-spotted Salamander, like most other animals, have their chromosomes (elements in the nucleus of every cell that contains the units, called genes, which possess the characteristics inherited by an animal) in pairs. Both of these species of salamanders have 14 sets of two chromosomes. This is called the diploid condition. However, in parts of the range of both species, notably where their ranges overlap, a portion of the females have 14 sets of three chromosomes. This is called the triploid condition. Uzzell suggests the triploid females were non-existent prior to glaciation and that they arose when the Jefferson's Salamander and Blue-spotted Salamander hybridized.

Mature triploid females found associated with Jefferson's Salamander resemble the Jefferson's Salamander but are usually smaller in overall size. Mature triploid females found associated with the Blue-spotted Salamander resemble the Blue-spotted Salamander but are usually larger in overall size. Uzzell found that the differences between the two types of triploid females were parallel to the differences between the Jefferson's Salamander and the Blue-spotted Salamander. That is, the triploid females associated with the Jefferson's Salamander have a broader snout, longer legs, greater body size and lighter colour than the triploid females associated with the Blue-spotted Salamander.

In order to distinguish between a triploid female and a diploid female Uzzell took blood samples from living individuals and measured the area of their red-blood cells. The cells of triploid females were 1.3 times larger than those of the diploid females. He also found that triploid females produced fewer eggs in relation to body size than diploid females.

The most interesting aspect of the complex is the breeding biology. Early in spring diploid males and females, as well as the triploid females, migrate to aquatic breeding sites. The males deposit spermatophores on the bottom and both types of females store the sperm capsule in the spermatheca until they are ready to lay their eggs. The results that follow, however, are significantly different. When a sperm cell makes contact with the egg of the diploid female, they unite and cell division begins, with the individual inheriting characteristics of both diploid parents. However, when a sperm cell makes contact with the egg of the triploid female, it does not unite with the egg; the action of the sperm cell merely stimulates the egg into cell division. The individual therefore inherits only the characteristics of the single triploid female parent.

Uzzell considered both types of triploid females distinct species because they are genetically isolated from both the diploid species and because, like the Jefferson's Salamander and the Blue-spotted Salamander, gene flow between them is not possible. He assigned the name Silvery Salamander, *A. plantinium*, to the triploid females associated with the Jefferson's Salamander and the name Tremblay's Salamander, *A. tremblayi*, to the triploid females associated with the Blue-spotted Salamander. However, Lazzell (1968) and Cook and Gorham (1981) have argued that because triploids cannot reproduce without diploid males they have to be considered hybrids and do not warrant spe-

cies status. Cook and Gorham (1981) suggested that Tremblay's Salamander was best considered "a triploid hybrid *A. laterale* x *jeffersonianum* which may be informally referred to as *A.2 laterale — jeffersonianum*."

In 1974 I completed a comparative study of data from fresh Nova Scotia blue-spotted mole salamanders with the result obtained by Uzzell. With the exception of three triploids found in the Thompson Station area, Cumberland County, all were either diploid male or female Blue-spotted Salamanders. Since this study, I have found four new localities in Cumberland County where triploid females exist, namely 3.2 km southwest of Little Tidnish River, Amherst Shore, Lower Shinimicas and Beecham Road.

Blue-spotted Salamander

Ambystoma laterale Hallowell

Variation

COLOUR OF ADULTS

Blue-spotted Salamanders are usually bluish-black all over but some individuals are paler on the underside. There are pale blue spots on the sides of the trunk and tail as well as on the chin, abdomen and limbs. The greatest concentration of blue spots, however, is along the sides of the trunk. On some individuals, particularly males, the spots are so frequent and prominent on the sides that they appear to form a pale blue stripe between the limbs. Triploid females are usually duller and have fewer spots than diploid females.

Some people confuse individuals of the leadback phase of the Eastern Redback Salamander, which have fine greyish-white spots on the sides of the trunk and tail, with the Blue-spotted Salamander (see Plate 1). The Blue-spotted Salamander is stouter in body form, the spots are larger and more vivid and there are 13 to 15 costal grooves compared to 18 to 20 on the Eastern Redback Salamander.

Table 2:
Length measurements in millimetres of 97 newly transformed Blue-spotted Salamanders from Nova Scotia

No. of Individuals, Locality	Body Length (Mean)	Tail Length (Mean)	Total Length (Mean)	Tail Length as % of Total Length (Mean)
71 (66)* (with a small body). Goodwin Road, Cumberland County	31.0-37.5 (34.8)	22.0-30.5 (26.8)	55.0-67.0 (61.7)	40 - 46 (44)
26 (25)* (with a large body), Goodwin Road, Cumberland County	39.0-44.0 (40.8)	30.0-39.0 (33.4)	69.0-82.0 (74.3)	42 - 48 (45)
97 (91)* The two above samples combined	31.0-44.0 (36.4)	22.0-39.0 (28.6)	55.0-82.0 (65.1)	40 - 48 (44)

*The numbers in parentheses represent the number of individuals which have a complete tail and were measured for tail and total length.

LENGTH OF NEWLY TRANSFORMED YOUNG

On July 28, 1981, between 0730 and 0915 hrs, a migration of newly transformed Blue-spotted Salamanders and Yellow-spotted Salamanders was observed crossing Goodwin Road, 8 km southwest of Lorneville, Cumberland County. Hundreds of these young salamanders crossed the gravel road and a sample of both species was collected. These specimens were measured (Table 2 and 5). Most of the individuals observed had remnant gill buds. The body length of 97 of these Blue-spotted Salamanders ranged from 31 to 44 mm. However, based on this measurement these salamanders can be separated into two groups: a group of 71 small salamanders which ranged from 31 to 37.5 mm in body length and a group of 26 larger salamanders which ranged from 39 to 44 mm in body length (Figure 28). The larger salamanders may have been triploid females.

The total length of 66 of the small-bodied Blue-spotted Salamanders ranged from 55 to 67 mm while the large-bodied individuals ranged from 69 to 82 mm.

LENGTH OF ADULTS

The body length of 173 males ranged from 45 to 70 mm and 106 diploid females ranged from 51 to 77 mm, while 18 triploid females ranged from 67 to 85 mm (Figure 29). The total length of 141 males ranged from 78 to 134 mm and 89 diploid females ranged from 95 to 140 mm; 15 triploid females ranged from 120 to 155 mm (Table 3).

Figure 28.

Body length measurements in millimetres of 97 newly transformed Blue-spotted Salamanders from Goodwin Road, Cumberland County

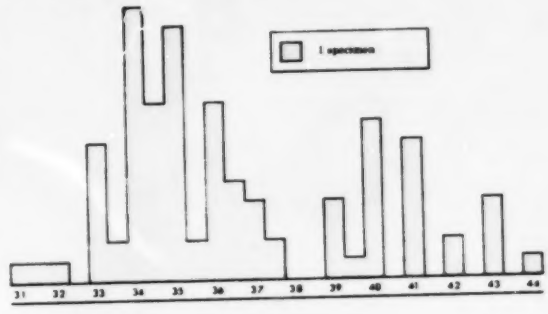


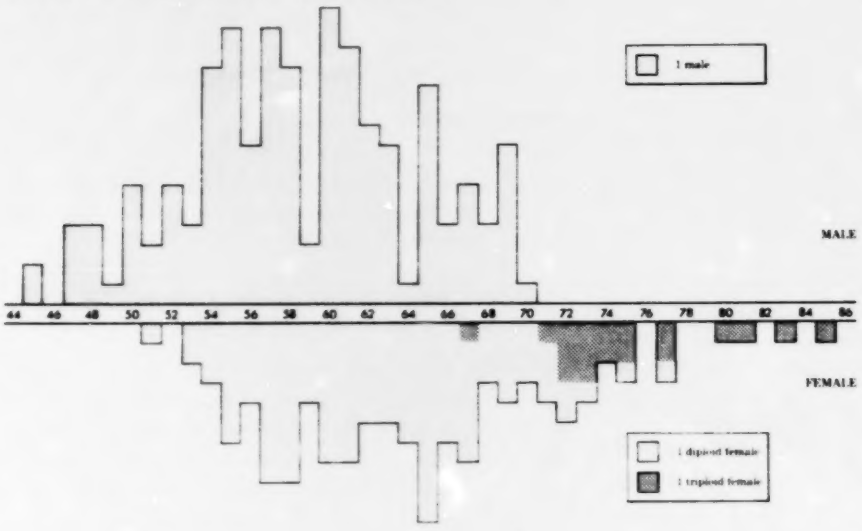
Table 3:
Length measurements in millimetres of 295 adult Blue-spotted Salamanders from Nova Scotia

No. of Individuals, Recorder, Years Collected	Body Length (Mean)	Tail Length (Mean)	Total Length (Mean)	Tail Length as % of Total Length (Mean)
3 males H. Piers, 1935			103.5-134.0 (118.5)	
173 (141)* males J. Gilhen, 1969-1980	45.0-70.0 (58.2)	33.0-65.0 (51.5)	78.0-134.0 (111.7)	39 - 51 (47)
106 (89)* diploid females J. Gilhen, 1969-1980	51.0-77.0 (64.8)	41.0-63.0 (48.7)	95.0-140.0 (114.3)	40 - 49 (44)
18 (15)* triploid females J. Gilhen, 1969-1980	67.0-85.0 (75.2)	52.0-75.0 (61.1)	120.0-155.0 (136.3)	42 - 48 (45)

*The numbers in parentheses represent the number of individuals which have a complete tail and were measured for tail length and total length.

Figure 29.

Body length measurements in millimetres of 297 adult Blue-spotted Salamanders from Nova Scotia (173 males, 106 diploid females and 18 triploid females)



COSTAL GROOVES

Costal grooves were counted on 311 individuals; 179 specimens (or 57.6%) had 15 grooves, 126 (40.5%) had 14 grooves and 6 (1.97%) had 13 grooves.

Distribution

The Blue-spotted Salamander occurs in the Maritime Provinces, Labrador, Quebec, Ontario and eastern Manitoba in Canada, and ranges south to New England, New York and extreme northern Ohio, Indiana and Illinois in the United States. In Nova Scotia this salamander is most common in the northern mainland, with a disjunct locality in the Kempt area, Queens County, and in five widely separated localities on Cape Breton Island (Figure 30).

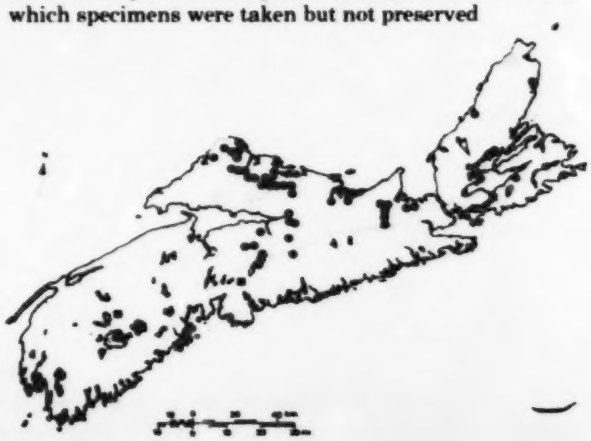
Habitat

The soils in the habitat of the Blue-spotted Salamander in Nova Scotia are derived from red sandstone, conglomerate, limestone and gypsum.

The reason for the apparent absence of this species along most of the Atlantic coastal area may be because of the natural acidity of the soils in these granite, slate and greywacke regions. The Blue-spotted Salamander inhabits coniferous, deciduous and mixed woodlands adjacent to alder swamps, ponds and slow-moving streams. The woodland next to these breeding sites is commonly a mixture of second growth, dominated by spruce, fir, maple and birch, with larch and aspen being common at

Figure 30.

Distribution of the Blue-spotted Salamander in Nova Scotia. Circles indicate localities from which specimens have been preserved; squares indicate localities from which specimens were taken but not preserved



some localities. A few roadside breeding ponds along Route 366, between East Amherst and Little Tidnish River, Cumberland County, are at the edge of coniferous woods dominated by spruce and fir; and a few breeding ponds along Route 104, between Mahoney Corner and River Philip, Cumberland County, are at the edge of deciduous woods dominated by birch.

Natural History

The earliest observation made for adults at spring breeding sites is April 9, 1951, in the Kempt area, Queens County, by J. Sherman Bleakney and J. Lynton Martin. Bleakney (1951) reported that they were common in that locality.

During the day Blue-spotted Salamanders usually remain under cover where they are not exposed to direct sunlight. They can be found by turning over rocks, stumps, logs and other loose surface material in damp places in the vicinity of aquatic breeding sites. The best time to observe them, however, is during wet nights from early April to about the middle of May. At that time the adults are migrating to and from breeding sites. For example, during a heavy mist, April 16, 1980, at 2100 hrs between 2 and 4.5 kilometres north of Route 6, on Beecham Road, Cumberland County, over 100 individuals were observed migrating to roadside breeding ponds. The greatest concentration of these salamanders was moving through a speckled alder swamp. Others were moving over leaf litter in mixed woods. Most individuals moved steadily from the swamp and woods up the roadbank until they were on the gravel road. Here they lingered for a short time, with heads held high as if smelling the air (Figure 31), before slowly crossing the road and entering one of a series of cattail ponds on the opposite side. Two individuals which had passed through a cattail ditch prior to moving up the roadbank were each transporting a pea clam, *Pisidium adamsi*, attached to a toe of a hind foot (Figure 32). During this impressive migration, a small number of Wood Frogs were vocal on the surface among the cattails of each pond. However, within the grass hummocks and sedges at the edge

Figure 32.

A pea clam attached to a hind toe of a Blue-spotted Salamander from Beecham Road, Cumberland County, on April 18, 1980

Figure 31.

Typical posture of an adult Blue-spotted Salamander pausing on wet road while migrating to a roadside pond. This adult was observed on the highway at Amherst Shore, Cumberland County, at 2030 hrs on May 3, 1978

of the ponds, they were surrounded and outvoiced by a larger number of Northern Spring Peepers.

Following the breeding season very few Blue-spotted Salamanders are seen on the roads during rainy nights until late July through September when newly transformed young leave their aquatic nursery to mature in terrestrial habitats. For example, on the rainy night of August 29, 1976, between 0230 and 0300 hours, two adults, three juveniles and seventeen large newly transformed individuals were observed on the wet highway at Lower Shinimicas, Cumberland County. The gill buds were still in evidence on most of the transformed individuals.

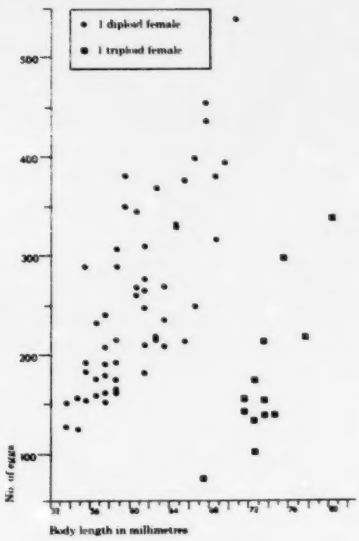
Blue-spotted Salamanders in Nova Scotia each year produce from 73 to 538 eggs (53 diploid females produced from 123 to 538 eggs and 13 triploid females produced from 73 to 337 eggs), (Figure 33).

The females usually lay their eggs individually at the base of vegetation, stones and other bottom material in the water. For example, at 0130 hrs, April 23, 1971, in a shallow roadside pond banked by grasses and sedges on Route 104, 3.3 km north of Route 2, Oxford area, Cumberland County, the base of a stone about 15 cm in diameter had been completely encircled with fresh-laid eggs. In two places, about 2.5 cm apart, were one group of three eggs and another of four eggs. Scattered throughout the pond were at least 50 males and 38 of them were each courting a female. Each male was sprawled lengthwise across the back of a female and was rubbing his snout along the side of the head of the female. Also at the time, with wet snow falling, one adult female Yellow-spotted Salamander entered the pond; a few Wood Frogs were calling on the surface among a small growth of cattails and a weak chorus of Northern Spring Peepers was heard from the cover of grass hummocks at the edge of the pond.

Adult and juvenile Blue-spotted Salamanders feed on a variety of small invertebrates. Adults apparently begin feeding soon after emerging from hibernation and take advantage of aquatic insect life at breeding sites. It is interesting to note that slugs, particularly *Deroceras* sp., which were introduced from Europe and thrive at the edge of woodlands along roadsides, and earthworms are the most important terrestrial prey during the spring. During the summer, snails, centipedes, earthworms and rove beetles are the most important prey.

Figure 33.

Number of ovarian eggs in relation to body length in 66 Blue-spotted Salamanders from Nova Scotia (circles indicate 53 diploid females and squares indicate 13 triploid females)



The stomachs of 352 Blue-spotted Salamanders were examined for food contents but only 96 stomachs contained identifiable prey. The prey included:

sowbugs (Isopoda)
centipedes (Chilopoda)
pseudoscorpion (Chelonethida)
harvestmen (Phalangida)
soil mites (Acarina)
spiders (Araneida)
springtails (Collembola)
mayfly nymph (Ephemeroptera)
dragonfly nymph (Odonata)
cricket (Gryllidae)
damsel bug (Nabidae)
ground beetles (Carabidae)
predacious diving beetle larvae (Dytiscidae)
water scavenger beetles (*Hydroporus* sp.)
rove beetles (Staphylinidae)
snout beetles (Curculionidae)
caddisfly larvae (Trichoptera)
moth larvae (Lepidoptera)
noctuid moth larvae (Noctuidae)

bagworm moth larva (Psychidae)
fly larvae (Diptera)
cranefly larva (Tipulidae)
midge larvae (Chironomidae)
braconid wasps (Braconidae)
chalcidid wasps (Chalcididae)
ants (Formicidae)
earthworms (*Eisenia* sp.)
land snails (*Euconulus fulves*, *Helicodiscus parallus*, *Retenilla* sp. and *Zonitoides* sp.)
slugs (*Arion* sp. and *Deroceras* sp.)

Bits of vegetation are taken incidentally, including:
grasses (Gramineae)
sedge fruit (*Carex* sp.)
rush capsules (*Juncus* sp.)
spruce needles (*Picea* sp.)
balsam fir needles (*Abies balsomea*) and
larch (*Larix laricina*)

The latest observation in autumn is September 17, 1976, on Route 366 at Amherst Shore, Cumberland County, when three females (two diploid and one triploid) were collected at night on wet pavement.

Yellow-spotted Salamander

Ambystoma maculatum (Shaw)

Variation

COLOUR OF ADULTS

Yellow-spotted Salamanders vary from dark greyish-brown to bluish-black on the back and sides of the head, trunk, tail and limbs. Their lower sides and abdomen are bluish-grey. On the top of the head, and continuing down the upper sides of the trunk and tail, there are usually two irregular rows of bright yellow spots. More rarely the spots are dull orange. In addition to these large spots, many individuals have yellowish-white to bluish-white flecks on the sides. Small greyish-white spots occur on the chin and abdomen.

The large bright spots on the back will readily distinguish the Yellow-spotted Salamander from other Maritime salamanders. The total number of these spots normally ranges from 17 to 54 (Table 4). Rarely, individuals have a greatly reduced number of spots. One adult male from North East Margaree, Inverness County, was completely unspotted (Figure 34).

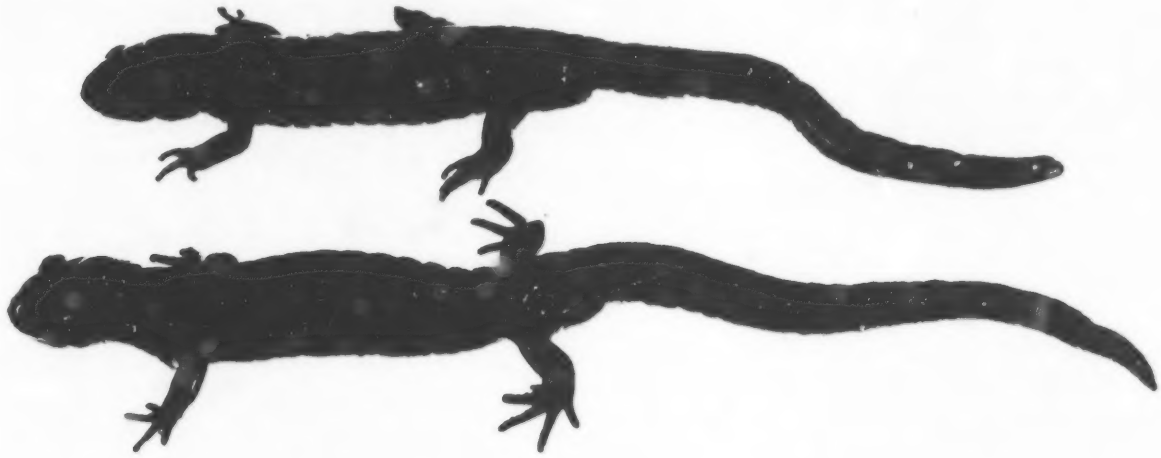
There are usually one or two spots on each leg but there may be as many as four. It is unusual for all four legs to be unspotted (Table 4).

Table 4:
Number of yellow spots on 430 Yellow-spotted Salamanders from Nova Scotia

No. of Yellow Spots	Head		Trunk		Tail		Total		Leg Total	
	320 Males	110 Females	320 Males	110 Females	260 Males	83 Females	260 Males	83 Females	320 Males	110 Females
Range	1 to 13	0 to 9	8 to 25	0 to 23	4 to 21	0 to 19	17 to 54	0 to 50	0 to 10	0 to 11
(Mean)	(4.9)	(4.6)	(14.6)	(14.6)	(11.2)	(11.2)	(30.7)	(30.2)	(4.8)	(6.2)

Figure 34.

Two adult Yellow-spotted Salamanders, one abnormal unspotted individual and one with typical spotted pattern, from North East Margaree, Inverness County, on May 14, 1975

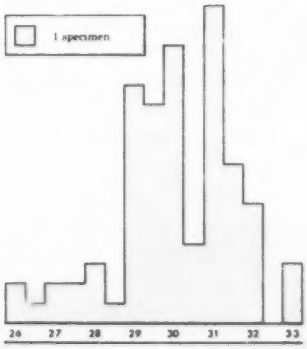


LENGTH OF NEWLY TRANSFORMED YOUNG

The body length of 81 newly transformed young ranged from 26.0 to 33.0 mm (Figure 35). The total length of these individuals ranged from 42.0 to 55.5 mm (Table 5). Bleakney (1951), however, reported a transformed specimen 40 mm in total length.

Figure 35.

Body length measurements in millimetres of 81 newly transformed Yellow-spotted Salamanders from Goodwin Road, Cumberland County, and Upper Middle River, Victoria County



LENGTH OF ADULTS

Female Yellow-spotted Salamanders are usually longer than males in body, tail and total length (Table 6). The body length of 285 males ranged from 58 to 93 mm, while that of 94 females ranged from 66 to 102 mm (Figure 36). The total length of 267 males ranged from 109 to 183 mm; 90 females ranged from 124 to 194 mm.

COSTAL GROOVES

Costal grooves were counted on 382 individuals: 361 specimens (94.5%) had 13 grooves, 15 (3.9%) had 12 grooves and 6 (1.6%) had 14 grooves.

Distribution

In Canada the Yellow-spotted Salamander occurs from Nova Scotia northwest to the Gaspé Peninsula and northwestern Ontario, and in the United States it extends south to Georgia and eastern Texas. In Nova Scotia it is the most widely distributed of the two species of mole salamanders. Breeding sites have been located in all regions of the province, including the plateau of the Cape Breton Highlands, 442 metres above sea level, and coastal areas close to the high tide mark (Figure 37).

Habitat

The Yellow-spotted Salamander inhabits the coniferous, deciduous and mixed woodlands adjacent to aquatic breeding sites. Natural breeding sites include woodland ponds, vegetated coves of lakes and quiet, vegetated portions of streams. However, practically any temporary or permanent roadside pond adjacent to woodland is a potential breeding site. Bleakney (1951) also included old wells as favourite egg-laying sites.

Natural History

The earliest observation of adult Yellow-spotted Salamanders during the spring breeding season is March 26, 1973, between 2000 and 2055 hrs when, during a light rain, adults were seen crossing

Table 5:
Length measurements in millimetres of 81 newly transformed Yellow-spotted Salamanders from Nova Scotia

No. of Individuals, Locality	Body Length (Mean)	Tail Length (Mean)	Total Length (Mean)	Tail Length as % of Total Length (Mean)
73 (61)* Goodwin Road, Cumberland County	27.5-33.0 (30.4)	18.5-24.5 (22.1)	46.5-55.5 (52.6)	39 - 44 (42)
8 Upper Middle River, Victoria County	26.0-29.5 (27.2)	15.5-21.5 (18.5)	42.0-51.0 (45.7)	37 - 43 (40)
81 (69)* (grouped together)	26.0-33.0 (28.8)	15.5-24.5 (20.3)	42.0-55.5 (49.2)	37 - 44 (41)

*The numbers in parentheses represent the number of individuals which have a complete tail and were measured for tail length and total length.

Table 6:
Length measurements in millimetres for 389 adult Yellow-spotted Salamanders from Nova Scotia

No. of Individuals, Recorder, Years Collected	Body Length (Mean)	Tail Length (Mean)	Total Length (Mean)	Tail Length as % of Total Length (Mean)
10 Specimens H. Piers, about 1899-1934			142.2-181.6 (162.1)	
285 (267)* Males J. Gilhen 1968-1980	58.0-93.0 (73.0)	45.0-96.0 (69.6)	109.0-183.0 (141.8)	40 - 53 (49)
94 (90)* Females J. Gilhen 1968-1980	66.0-102.0 (83.4)	56.0-94.0 (74.8)	124.0-194.0 157.6)	38 - 53 (48)

*The numbers in parentheses represent the number of individuals which have a complete tail and were measured for tail length and total length.

Figure 36.

Body length measurements in millimetres of 379 adult Yellow-spotted Salamanders from Nova Scotia (285 males and 94 females)

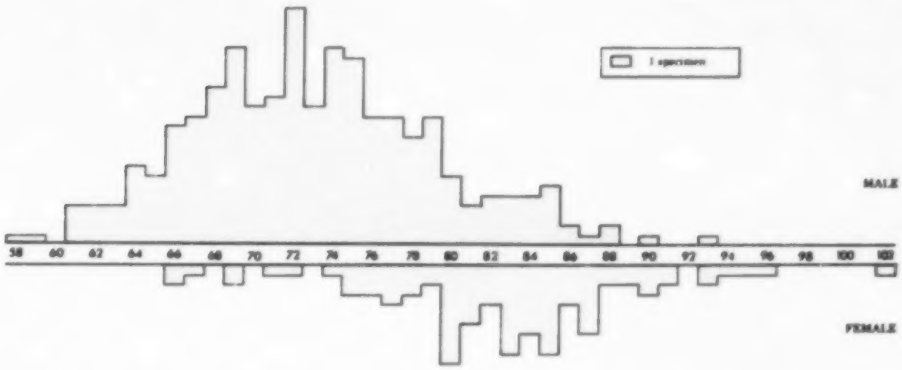


Figure 37.

Distribution of the Yellow-spotted Salamander in Nova Scotia

Route 325 between Colpton and West Clifford, Lunenburg County. They were accompanied by Northern Spring Peepers and Wood Frogs.

During the day Yellow-spotted Salamanders usually remain under cover of rocks, stumps, logs and other loose surface material in damp places. On moist or rainy nights in spring, summer and autumn they move about the surface of the forest floor. There are a number of records of individuals crossing roads under these conditions. Like the Blue-spotted Salamander, large numbers of adults can be observed on rainy nights during April and May when they are migrating to and from aquatic breeding sites (Figure 38).

During the overcast night of May 13, 1975, at 2115 hrs two males were observed courting one female in a roadside cattail pond at West Bay Road, Kingsville area, Inverness County. Each male moved along the bottom and gently bumped into the side of the female's body, as though nudging her with his head, then he would slide under or over her body and turn around to repeat the performance, rising to the surface occasionally for air (Figure 39). About 12 males and four females were seen in the pond between 2100 and 2300 hrs. Spermatophores were common on the bottom (Figure 40) but no Yellow-spotted Salamander eggs were seen. During this time four Eastern American Toads and a large number of Northern Spring Peepers were vocal at the margin of the pond while an active aggregation of about 20 male Wood Frogs were vocal and moving about the surface of the pond.

Figure 38.

Adult Yellow-spotted Salamander pausing on wet highway while migrating to a roadside pond at Lake O'Law, Inverness County, 2305 hrs, on May 14, 1975

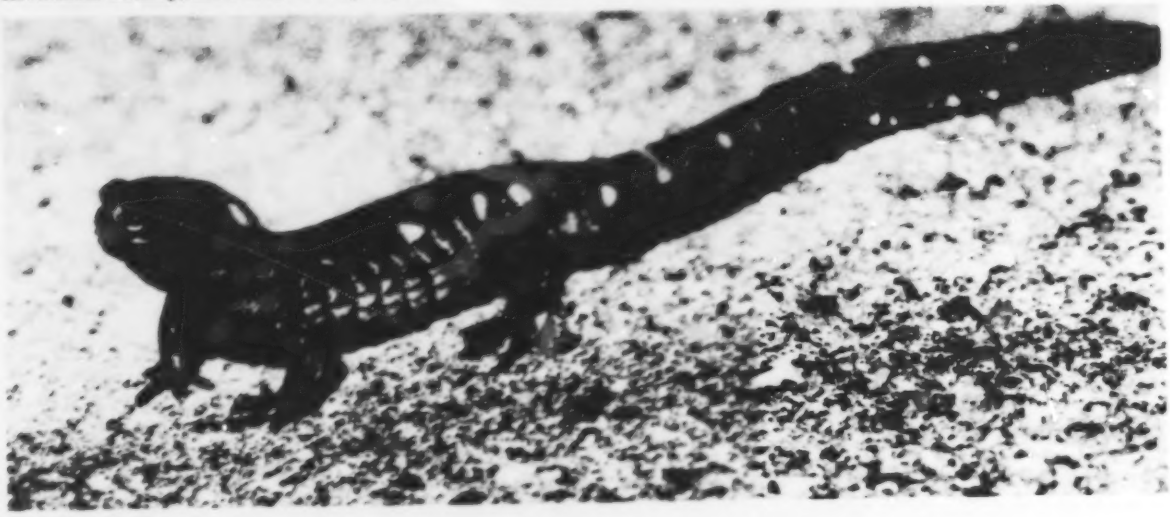


Figure 39.

Two adult male Yellow-spotted Salamanders courting an adult female in the gravelly shallows of a roadside cattail pond at Kingsville, Inverness County, on May 13, 1975

Figure 40.

Yellow-spotted Salamander spermatophores deposited on dead submerged cattails in the shallows of a roadside pond at Kingsville, Inverness County, on May 13, 1975

On April 25, 1978 at 2200 hrs, about 20 females and four males were observed migrating along a slow stream in a drainage ditch at Watford, Lunenburg County (Figure 41). Four females were observed depositing their eggs on overhanging submerged grass in a pool (Figure 42).

Adult female Yellow-spotted Salamanders each year produce from 81 to 293 eggs (Figure 43), which may be laid in one large brain-shaped mass or in a number of smaller clumps (Figure 44). The eggs may be fixed to vegetation such as cattails, submerged grasses and sedges, or rest on the bottom and look like beach stones as they gradually become coated with a thin layer of silt.

Yellow-spotted Salamander larvae develop rapidly in shallow ponds and transform during July, August and September. Those larvae developing in shaded woodland ponds, cool streams or coves or lakes may overwinter as larvae and transform the following spring. For example, larvae usually overwinter at the "Heart-shaped Pond" at Prince's

Figure 41.

An adult female Yellow-spotted Salamander migrating down a narrow temporary stream to a small roadside breeding pond at Watford, Lunenburg County, at 2150 hrs on April 25, 1978

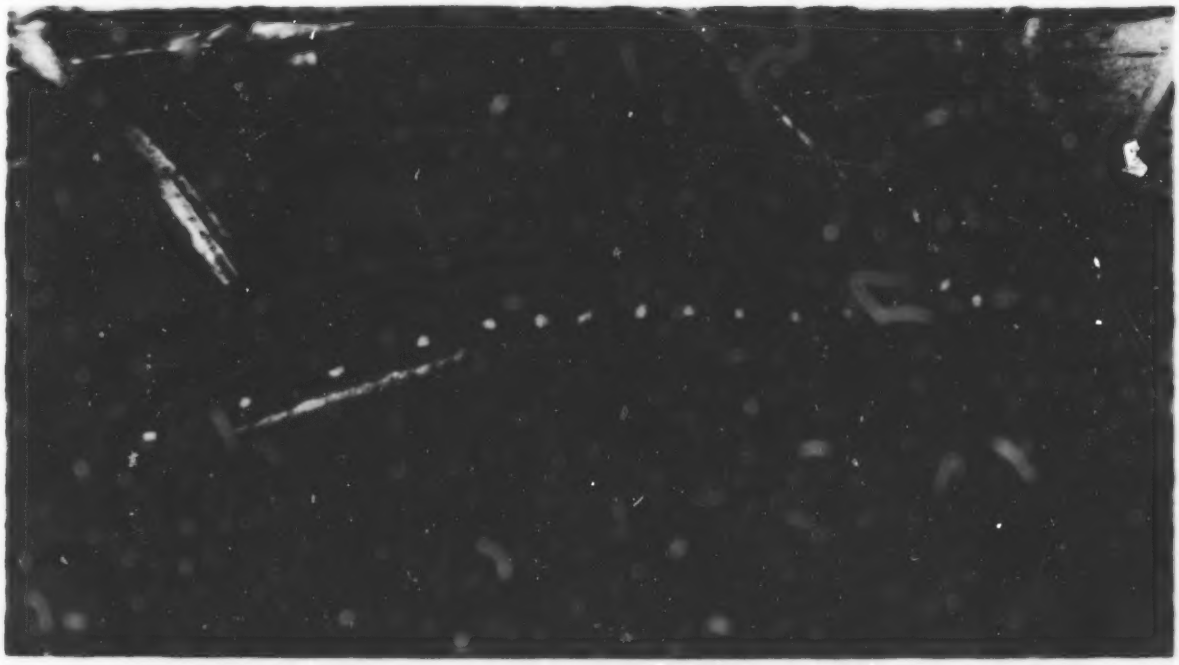


Figure 42.

An adult female Yellow-spotted Salamander laying eggs on submerged grass in a roadside breeding pond at Watford, Lunenburg County, at 2200 hrs on April 25, 1978

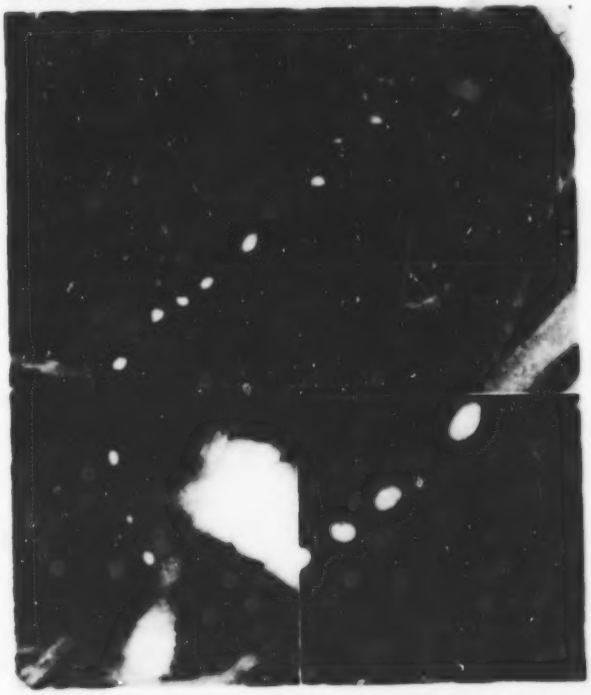


Figure 43.

Number of ovarian eggs in relation to body length in 58 Yellow-spotted Salamanders from Nova Scotia

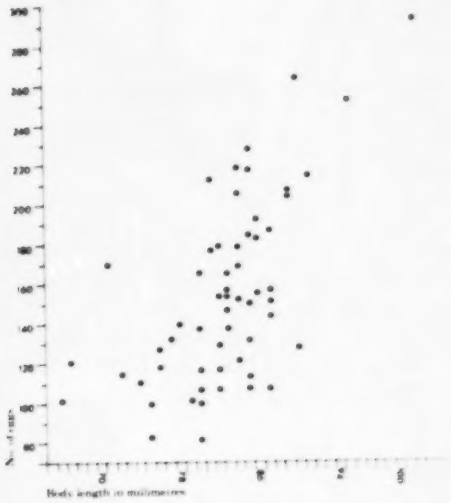


Figure 44.

Yellow-spotted Salamander eggs fixed to submerged grass in a roadside breeding pond at Watford, Lunenburg County, on April 25, 1978

Lodge, Halifax County. Bleakney (1951) observed this phenomenon at a pond on Wolfville Ridge, Kings County.

Adult and juvenile Yellow-spotted Salamanders feed on a variety of small invertebrates. They begin feeding soon after emerging from hibernation. However, there is less evidence of this species feeding underwater during their stay at aquatic breeding sites than there is for Blue-spotted Salamanders. Their food consists largely of spiders, terrestrial snails, slugs, earthworms and beetles. Terrestrial snails are especially important in the diet of juveniles.

A total of 405 Yellow-spotted Salamanders were examined for stomach contents. Most individuals had ingested some silt, sand or gravel as well as bits of bark, conifer needles or grasses. The stomachs of only 72 individuals contained identifiable animal remains. The prey included:

millipedes (Diplopoda)
centipedes (Chilopoda)
harvestmen (Phalangida)
soil mites (Acarina)
spiders (Araneida)
damselfly nymph (Odonata)
plant bug nymph (Miridae)
beetle larvae (Coleoptera)
ground beetles (Carabidae)
predacious diving beetle larva (Dytiscidae)
rove beetles (Staphylinidae)

click beetle larva (Elateroidea)
weevils (Mylabridae)
moth larva (Lepidoptera)
fungus gnat (Mycetophilidae)
ants (Formicidae)
earthworms (Oligochaeta)
land snails (*Cionella lubrica*, *Discus chronkhitei*, *Zonitoides* sp. and *Retinella* sp.)
slugs (*Arion* sp. and *Deroceras* sp.)

The latest observation date recorded in November 4, 1982, when a live young individual and two road-killed adults were found on the highway in the Forties Settlement area, Lunenburg County.

The Newts

Family Salamandridae

This family of aquatic salamanders is found mostly in Europe and Asia. Of the 14 genera, which comprise 43 species presently known to science, only two genera and six species are native to North America. The Eastern Newt, *Notophthalmus viridescens*, is native to eastern North America and is a complex of four subspecies. The Red-spotted Newt, *N. v. viridescens*, represents this species and the newt family in the Maritime Provinces.

The costal grooves on newts are ill-defined. Newts are easier to hold than the salamanders of other families because their skin is comparatively rough and less moist.

Red-spotted Newt

Notophthalmus viridescens viridescens
(Rafinesque)

Variation

COLOUR OF JUVENILES

Juvenile Red-spotted Newts, called red efts, are reddish-orange on the back, sides and underside. The back may be dusky, particularly when an individual is about to shed its skin. There are usually red spots, bordered in black, in two rows down the back. The number of red spots on 51 older red efts from various localities ranged from 0 to 21 (mean 8.8) (Table 7). There are variable numbers of black dots on the underside.

Table 7:
Number of red spots on Red-spotted Newts from Nova Scotia

No. of Individuals, Maturity, Sex	Range	Mean
51 older juveniles	0 to 21	8.8
73 adult males	0 to 18	9.3
64 adult females*	0 to 21	8.7

*One adult female (not included here) had an abnormal count of 58 red spots.

COLOUR OF ADULTS

Adult Red-spotted Newts vary in colour, depending on age and sex. Young adults, those which have recently entered aquatic habitats, gradually lose their reddish-orange terrestrial colour and become olive-green on the back and upper sides. The lower sides and underside become yellow. The adults, however, retain their red spots, bordered in black, on the back as well as the black dots on the underside. They also acquire variable numbers of black spots on the back of the trunk and sides of the tail. The number of red spots on 73 adult males from various localities ranged from 0 to 18 (average 9.3), while the number of red spots on 65 females ranged from 0 to 58 (average 9.3) (Table 7).

LENGTH OF NEWLY TRANSFORMED YOUNG

The body length of 29 newly transformed young

ranged from 18.5 to 24.5 mm (Figure 45). The total length of these individuals ranged from 34 to 45 mm (Table 8).

LENGTH OF ADULTS

The body length of 73 males ranged from 36 to 56 mm and 64 females ranged from 37 to 57 mm (Figure 46). The total length of 103 males ranged from 73 to 114.3 mm and 110 females from 69.8 to 123.8 mm (Table 8).

Figure 45.

Body length measurements in millimetres of 29 newly transformed red efts from Nova Scotia

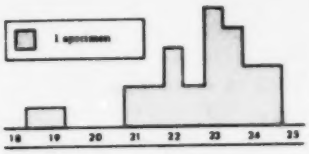


Figure 46.

Body length measurements in millimetres of 137 adult Red-spotted Newts from Nova Scotia (73 males and 64 females)

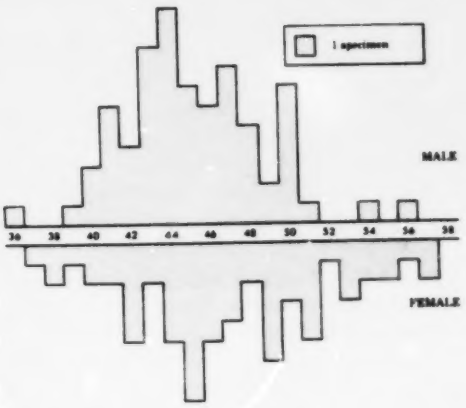


Table 8:
Length measurements in millimetres of 330 Red-spotted Newts from Nova Scotia

No. of Individuals, Maturity, Sex, Recorder, Years Collected	Body Length Range (Mean)	Total Length Range (Mean)	Tail Length as % of total Length Range (Mean)
29 newly transformed juveniles, J. Gilhen, 1976	18.5-24.5 (22.6)	34.0-45.0 (41.5)	39 - 48 (46)
88 older juveniles, J. Gilhen, 1968-1980	25.0-49.0 (36.3)	43.0-92.0 (67.7)	41 - 50 (47)
30 adult males, J. S. Bleakney, 1950		76.2-114.3 (92.5)	
73 adult males, J. Gilhen, 1968-1981	36.0-56.0 (45.2)	73.0-106.0 (91.3)	45 - 55 (51)
49 adult females, J. S. Bleakney, 1950		69.8-123.8 (86.3)	
64 (61)* adult females, J. Gilhen, 1968-1981	37.0-57.0 (46.9)	70.0-119.0 (94.5)	46 - 54 (50)

*The numbers in parentheses represent the number of individuals which have a complete tail and were measured for tail length and total length.

Distribution

In Canada the Red-spotted Newt occurs throughout the Maritime Provinces west to northwestern Ontario and in the United States it ranges south to central Georgia and Alabama. In Nova Scotia this salamander is common in all regions of the mainland and Cape Breton Island (Figure 47).

Figure 47.

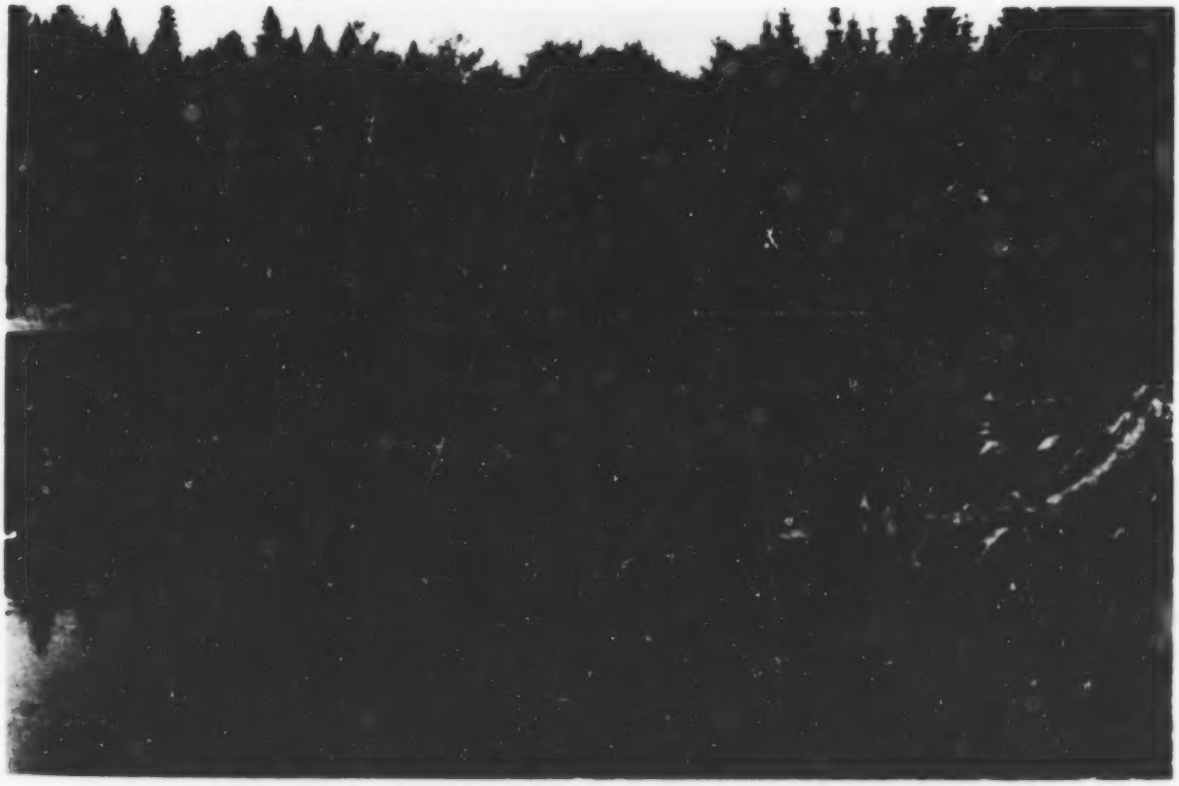
Distribution of the Red-spotted Newt in Nova Scotia

Habitat

On completing the summer aquatic larval stage, the newly transformed young take up residence in damp, deciduous, coniferous or mixed woodlands in the vicinity of aquatic habitats, for probably two years. After completing the terrestrial juvenile stage they make their way back to vegetated coves of lakes (Figure 48), woodland ponds, oxbow ponds and quiet stretches of streams. They will invade a variety of man-made ponds, such as ponds in gravel pits or along roadsides, and fire wells.

Figure 48.

Vegetated soft-bottomed shallows of Lily Lake, Colchester County. Adult Red-spotted Newts and Mink Frogs as well as juvenile Pickerel Frogs are common there



Natural History

Adult Red-spotted Newts are active on the bottom of aquatic habitats and forage among the vegetation during the day and night throughout spring, summer and autumn. Individuals have even been observed during the winter moving about the bottom of ponds under the ice.

Males court females from late March to late May. Breeding males develop a high, wavy crest on their tail and a series of black excrescences, or pads, on the underside of the enlarged hind legs.

On March 26, 1981, between 1330 and 1445 hrs on the bottom of a partially ice-covered roadside pond at Colpton, Lunenburg County, three out of 15 males observed were each courting a female. Each male was positioned above and forward of the female and with his hind legs had a firm grip on the sides of the female just behind her forelegs. The head of each male was arched downward in front of the female so that the side of his head was rubbing her snout. The tail of each male was bent forward along the side of the female's trunk and head. None of the males, however, was making fanning motions with its tail, a characteristic of male courtship behaviour.

Female Red-spotted Newts lay their eggs singly on the leaves and stems of aquatic plants. On May 12, 1980, at 2145 hrs a young adult male was observed in a roadside sphagnum pond in the Milford area, Hants County, eating fresh-laid Red-spotted Newt eggs which it exposed as it slowly moved between the loose clumps of sphagnum plants.

Figure 49.

Number of pigmented ovarian eggs in relation to body length in 38 Red-spotted Newts from Nova Scotia (circles indicate 30 aquatic adults and squares indicate eight sexually mature red efts)

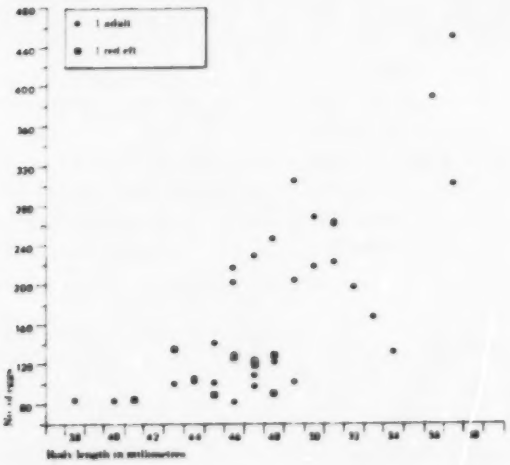


Figure 50.

Red eft pausing on a boulder near the shallows of Lily Lake, Colchester County, at 2358 hrs on June 12, 1978

Large female red efts are sexually mature by the time they are ready to migrate to aquatic habitats. The ovarian pigmented egg counts of eight red efts ranged from 85 to 135 (Figure 49). The ovarian pigmented egg counts of 30 adult females ranged from 84 to 451 (Figure 49).

Red-spotted Newt larvae grow rapidly and transform in August and September. During a light, warm rain on September 5, 1976, between 0030 and 0120 hrs, a large number of newly transformed red efts was observed migrating from a vegetated roadside pond across a paved highway to mixed woods adjacent to John Smith Brook, Cumberland County. Also on the wet pavement were larger red efts of two distinct size groups. There were 20 individuals which ranged from 58 to 60 mm and 11 which ranged from 70.5 to 86 mm. The newly transformed ones were leaving the pond to begin a two-year juvenile stage, while the largest ones had completed a two-year juvenile stage and were migrating back to the pond to begin their adult aquatic life. The remaining 20 red efts had completed their first year as juveniles; showing no pattern of migration, they merely lingered about the wet pavement.

Red efts are active on the surface of the forest floor, along lake shores (Figure 50) and crossing roads on humid or rainy nights during spring, summer and autumn. Also there are a number of reports of individuals observed moving about during the day. For example, on October 23, 1980, at

1015 hrs, I observed five red efts resting in wet spots on railway ties while I was walking along a 100 metre section of railway tracks at St. Peters, Richmond County. At 1100 hrs, four of these red efts were still present, their reddish-orange colour pattern conspicuous on the creosoted ties.

The aquatic larvae feed on a variety of small invertebrates. A sample of six larvae from a stream at Beecham Road, Cumberland County, had eaten the following prey:

water fleas (Cladocera)
ostracods (Ostracoda)
copepods (Copepoda)
amphipods (Amphipoda)
predacious diving beetle larvae (Dytiscidae)
caddisfly larvae (Trichoptera)
pea clam (Sphaeriidae)
snails (*Helisoma* sp.)

The terrestrial juveniles prey heavily on small invertebrates that inhabit the humus and leaf litter of the forest floor, particularly snails, springtails and soil mites. The following identifiable prey were found in the stomachs of 88 red efts:

soil mites (Acarina)
spiders (Araneida)
springtails (Collembola)
fly larvae (Diptera)
snails (Succiniedae, *Cionella lubrica*, *Vertigo* sp., *Zoogenetes harpa*, *Helicodiscus parallelus*, Zonitidae, *Retinella* sp., *Zonitoides* sp. and *Vitrina limpida*)

Adult Red-spotted Newts prey heavily on the aquatic immature stages of insects, particularly midges. The following prey were found in the stomachs of 110 Red-spotted Newts:

Mayfly nymphs (Ephemeroptera)
dragonfly and damselfly nymphs (Odonata)
stonefly nymphs (Plecoptera)
water boatmen (Hemiptera)
juvenile giant water bugs (*Belostoma flumineus*)
predacious diving beetle larvae (Dytiscidae)
caddisfly larva (Trichoptera)
midge larvae and pupae (Chironomidae)
pea clam (Sphaeriidae)
earthworm (Oligochaeta)
leech (Hirudinea)
Blue-spotted Salamander egg
Red-spotted Newt eggs, larvae and shed skin

The Lungless Salamanders

Family Plethodontidae

As the family name implies, the 23 genera, consisting of the 214 species presently known, do not have lungs. Most species are known only from America. These salamanders breathe through their skin and the lining of the roof of the mouth. Moisture is essential to their survival. Characteristic of this family, but often difficult to see unless examined with a magnifying glass, is the "nasolabial groove", a small but distinct groove from the nostril to the upper lip (Figure 26).

There are seven genera and eight species of lungless salamanders recorded from Canada. Only two genera, each represented by a single species, are native to Nova Scotia.

Eastern Redback Salamander

Plethodon cinereus (Green)

Variation

COLOUR OF ADULTS

The Eastern Redback Salamander is variable in colour. There are three distinct colour phases: a striped or redback phase, a non-striped or leadback phase and an all-red or erythristic phase.

The stripe down the back of the redback phase varies from red-brown to orange-brown, yellowish-brown, chocolate-brown or greenish-brown. The shade depends in part on the amount of fine black speckling on the stripe. The stripe usually begins on the back of the head and ends at a point usually on the posterior two-thirds of the tail. The front of the head and the part of the tail not included in the stripe are greyish-black to black. The upper sides are black but may include some fine speckling of silvery-yellow or be mottled with some of the colour intruding from the stripe. The lower sides and underside are mottled grey and black. The chin is pale yellowish-grey with some grey spotting. The underside of the tail varies from greyish-black to black and may include some fine grey spots.

The back in the leadback phase varies from shades of light to dark chocolate-brown, dark grey or black. The shade may be uniform or finely speckled with greyish-white or silvery-yellow. One individual from the Albro Lake area, Halifax County, was speckled with silvery-yellow on the tail and with greyish-white on the trunk. The colouring of the underside in this phase is the same as that of the redback phase.

The all-red or erythristic phase varies from pinkish-orange to orange-red on the back and upper sides, with variable amounts of black spotting on the trunk and black blotches on the tail. (One individual from the Poison Lake area, Cum-

Table 9:
Length measurements in millimetres of 427 Eastern Redback Salamanders from Nova Scotia

No. of Individuals, Maturity, Sex, Recorder, Years collected	Body Length Range (Mean)	Total Length Range (Mean)	Tail Length as % of total Length Range (Mean)
6 (5)* newly hatched young, J. Gilhen, 1979	12.0-12.7 (12.5)	18.0-19.5 (19.0)	33 - 36 (35)
51 adult males, J. S. Bleakney, 1950		63.5-95.3 (78.4)	
209 (95)* adult males, J. Gilhen, 1967-1981	35.0-49.0 (41.7)	68.0-97.0 (80.6)	42 - 51 (48)
43 adult females, J. S. Bleakney, 1950		66.7-98.4 (79.7)	
118 (82)* adult females, J. Gilhen, 1967-1981	39.0-51.0 (44.4)	72.0-100.0 (84.6)	42 - 52 (48)

*The numbers in parentheses represent the number of individuals which have a complete tail and were measured for tail length and total length.

berland County, was pinkish-white and, with the black eyes and black blotches on the tail, is best described as a partial albino. Another individual from the same locality had an unusual amount of black on the back and the pattern was a mosaic of orange and black blotches.) The lower sides and underside in this phase are pale yellow on the chin, mixing with pinkish-yellow and pale grey spots on the abdomen and becoming greyish-black to black on the tail.

Many chocolate-brown individuals of the redback phase could be mistaken for the leadback phase because, unless examined closely, there is no obvious line of distinction between the dark stripe and the black sides. Some of these dark specimens also have some speckling of greyish-white or silvery-yellow and look intermediate between the two phases.

It is interesting to note that individuals of the leadback phase that have greyish-white speckling have been incorrectly identified as Blue-spotted Salamanders by persons unfamiliar with these two species.

LENGTH OF NEWLY HATCHED YOUNG

The body length of six newly hatched young ranged from 12 to 12.7 mm. The total length of five of these individuals ranged from 18 to 19.5 mm (Table 9).

LENGTH OF ADULTS

The body length of 209 males ranged from 35 to 49 mm while that of 118 females ranged from 39 to 51 mm (Figure 51). The total length of 95 males ranged from 68 to 97 mm; 82 females ranged from 72 to 100 mm (Table 9).

COSTAL GROOVES

Costal grooves were counted on 363 individuals: 292 specimens (80.4%) had 19 grooves, 56 (15.4%) had 20 grooves and 15 (4.1%) had 18 grooves.

Distribution

In Canada the Eastern Redback Salamander ranges from the Maritime Provinces west to northwestern Ontario. In the United States it extends south to North Carolina, west to southeastern Missouri and northwest to Minnesota. In Nova Scotia this salamander is common in all regions of the mainland and Cape Breton Island (Figure 52). The erythristic phase has been recorded from North Mountain at Sandy Lake, Annapolis County, from the Cobequid Mountains at Poison Lake, Cumberland County, Simpson and West Lakes, Colchester County and on the Pictou highlands at Upper Mount Thom, Pictou County. In large samples (25 specimens or more) from localities where it occurs, the erythristic phase represents 15 per cent or less of the population.

Figure 51.

Body length measurements in millimetres of 327 adult Eastern Redback Salamanders from Nova Scotia (209 males and 188 females)

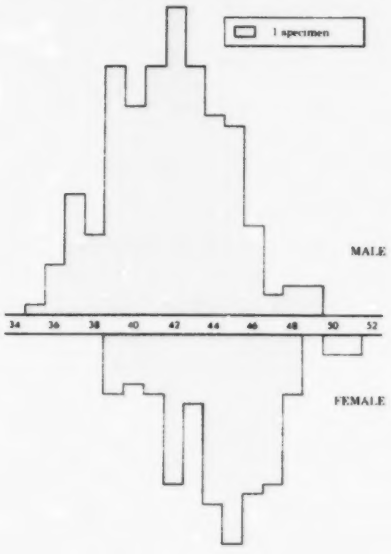
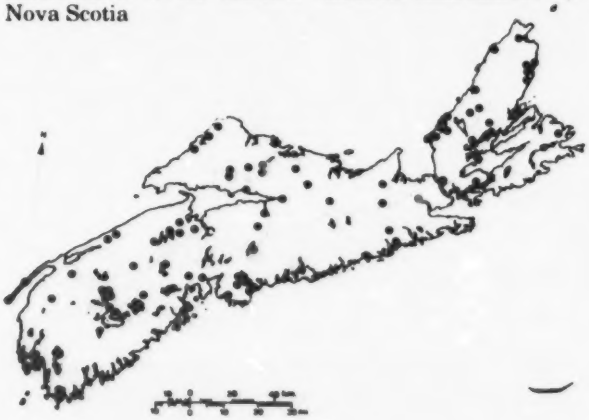


Figure 52.

Distribution of the Eastern Redback Salamander in Nova Scotia



Habitat

The Eastern Redback Salamander inhabits deciduous, coniferous and mixed woods. The redback phase is the dominant phase, particularly in deciduous woods. The leadback phase, and the intermediates which tend to be associated with this phase, are common in coniferous woods and mixed woods, particularly in coastal regions, and become less common to scarce in deciduous woods, particularly in the highlands and mountains. The uncommon erythristic phase is found in deciduous woods (Figure 53), particularly in those dominated by maples in highlands and mountains 153 metres or more above sea level. In this type of habitat the erythristic phase seems to replace the pure leadback phase.

Natural History

The Eastern Redback Salamander becomes active early in spring as soon as the forest floor has thawed. The earliest record for spring is April 9, 1968, when two adults were found under rocks at the edge of Kearney Run, Halifax County.

During the day this species usually remains concealed under a variety of surface materials, particularly rocks and loose bark, and within moist,

Figure 53.

Habitat near Simpson Lake, Colchester County, where erythristic and redback phases of the Eastern Redback Salamander are found

decaying stumps and logs. On damp or rainy nights they are active on the surface of the forest floor or along roadsides, and some individuals will cross wet highways. For example, on the foggy night of July 3, 1980, between 2100 and 2200 hrs, 17 individuals were observed foraging along a bulldozed road bank near coniferous woods at Herring Cove, Halifax County (Figure 54).

Although this salamander is considered to be a woodland species, it commonly invades back yards in suburban areas. Here individuals take cover under firewood, boards and other debris and under rocks in gardens.

Adult female Eastern Redback Salamanders produce from four to 17 eggs in one year (Figure 55). The eggs are laid individually, but cling together, in a secluded cavity in a damp place under a rock or within a decaying stump or log, from late May through June. The larval stage is passed in the enclosed aquatic environment of the egg capsule and the young hatch in August or September of the same year. The vigilant female remains close to and protects her eggs during the incubation period.

The Eastern Redback Salamander feeds on a variety of invertebrates which are associated with the humus, leaf and needle litter and decaying wood of the forest floor. They prey heavily on ants, beetles (particularly beetle larvae), mites, spiders, springtails and small flies (particularly fly larvae). Other important food items include snails, millipedes, centipedes, isopods and moth larvae.

From the stomachs of 164 individuals the following prey was identified:

earthworm (Oligochaeta)
sowbugs (Isopoda)
millipedes (Diplopoda)
centipedes (Chilopoda)
pseudoscorpions (Chelonethida)
mites and ticks (Acarina)
spiders (Araneida)
springtails (Collembola)
cricket (Gryllidae)
leaf bugs (Miridae)
aphid (Aphididae)
ground beetle larvae and adults (Carabidae)
rove beetles (Staphylinidae)
fireflies (Lampyridae)
click beetle larvae and adults (Elateridae)
sap beetle (Nitidulidae)
minute brown scavenger beetles (Lathridiidae)
ladybird beetle (Coccinellidae)
darkling beetle (Tenebrionidae)
leaf beetle (Chrysomelidae)
noctuid moth larvae (Noctuidae)
gelechid moth pupae (Gelechiidae)
black flies (Simuliidae)
Fungus gnat larvae and adults (Mycetophilidae)
muscid fly larvae (Muscidae)
tortricid moth larvae (Tortricidae)
braconid wasps (Braconidae)
ants (Formicidae)
snails (*Retinella* sp., *Zonitoides* sp., *Euconulus fulvus, Discus cronkhitei, Zoogenetes harpa* and *Vertigo* sp.)

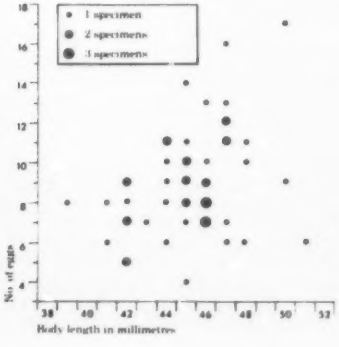
The latest observation date recorded is November 4, 1982, when a juvenile was found on wet highway at Forties Settlement area, Lunenburg County.

Figure 54.

Adult leadback phase of the Eastern Redback Salamander active along the roadside at Herring Cove, Halifax County, at 2150 hrs on July 3, 1980

Figure 55.

Number of ovarian eggs in relation to body length in 58 Eastern Redback Salamanders from Nova Scotia.



Four-toed Salamander

Hemidactylium scutatum (Schlegel)

Variation
Males and females differ in the shape of the head. The snout of the male is elongated and almost square and that of the female is short and rounded.

COLOUR OF ADULTS

The Four-toed Salamander varies from orange-brown to reddish-brown above with small patches of fine black spots on the back of the trunk, extending down the sides of the head, tail and limbs. The sides of the body are mottled with white, grey and black spots. The upper sides are darker than the lower sides. The underside is enamel-white sprinkled with small black dots. This species is the only salamander native to the Maritime Provinces that has a white abdomen.

LENGTH OF ADULTS

The body length of nine males ranged from 22 to 31 mm and that of eight females ranged from 22.5 to 40 mm (Figure 56). The total length of 10 males ranged from 44.5 to 79.4 mm and that of eight females from 43.5 to 90 mm (Table 10).

Figure 56.

Body length measurements in millimetres of 17 adult Four-toed Salamanders from Nova Scotia (9 males and 8 females)

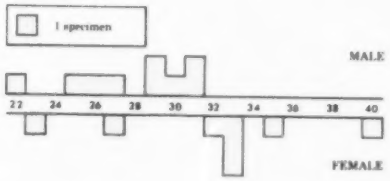


Table 10:
Length measurements in millimetres of 35 Four-toed Salamanders from Nova Scotia

No. of Individuals, Maturity, Sex, Years collected	Body Length Range (Mean)	Total Length Range (Mean)	Tail Length as % of total Lenth Range (Mean)
15 newly hatched larvae J. Gilhen, 1976		11.5-12.5 (12.3)	
1 adult male H. Piers, 1934		65.0	
1 adult male N. D. Richmond, 1950		76.0	
1 adult male J. S. Bleakney, 1951		79.4	
9 (7)* adult males J. Gilhen, 1968-1975	22.0-31.0 (27.7)	44.5-67.0 (56.2)	48 - 54 (52)
8 adult females J. Gilhen, 1968-1976	22.5-40.0 (31.8)	43.5-90.0 (66.6)	48 - 56 (52)

*The numbers in parentheses represent the number of individuals which have a complete tail.

COSTAL GROOVES

Costal grooves were counted on 29 individuals; 22 specimens (or 75.9%) had 15 grooves and seven (or 24.1%) had 14 grooves.

Distribution

In Canada the Four-toed Salamander is native to Nova Scotia, southern Quebec and southern Ontario. In the United States its range extends from southern Maine to Wisconsin and south to Alabama, with disjunct populations further west and south. In Nova Scotia it has been found on the mainland and on Cape Breton Island. Except in the south-central mainland, most localities are widely separated (Figure 57).

Figure 57.

Distribution of the Four-toed Salamander in Nova Scotia

Habitat

The Four-toed Salamander is closely associated with sphagnum areas bordering streams and in sphagnum bogs during the spring breeding season. During the summer individuals have been found in and close to woodland situations. For example, on September 16, 1974, an adult female was found under a rock on a ridge in deciduous woods about 150 metres from a sluggish stream at Westphal, Halifax County, and on August 7, 1972, an adult female was found under a piece of cardboard in a blueberry patch in a field about five metres from coniferous woods at Marie Joseph, Guysborough County.

Natural History

During April and early May mature female Four-toed Salamanders select suitable egg-laying sites. At Crosskill Lake, Annapolis County, the sphagnum-laden bases of standing dead conifers, stumps and logs were used as nesting sites (Figure 58). Deep between the sphagnum plants the female lays her eggs. The eggs cling together and are placed in situations where the larvae, upon hatching, can wriggle further downwards through the sphagnum and drop into the water (Figure 59).

Based on counts of enlarged ovarian eggs in four females, Four-toed Salamanders in Nova Scotia produce from 24 to 37 eggs each year (Figure 60). Five nests uncovered at Crosskill Lake, Annapolis County, contained 19, 20, 22, 25 and 27 eggs.

Four-toed Salamanders feed on a variety of invertebrates. Of 18 individuals examined, nine had identifiable animal remains in their stomachs. The following prey had been eaten:

- ticks (Acarina)
- spiders (Araneida)
- springtails (Collembola)
- midges (Chironomidae)
- ground beetles (Carabidae)
- rove beetles (Staphylinidae)
- fly larvae (Tipulidae and Tabanidae)
- parasitic wasp (Chalcididae)
- ant (Formicidae)
- snails (Pupillidae and Zonitidae)

Figure 59.

A female Four-toed Salamander guarding her eggs, which cling together secluded in the sphagnum moss

Figure 60.

Number of eggs in relation to body length in four Four-toed Salamanders from Nova Scotia

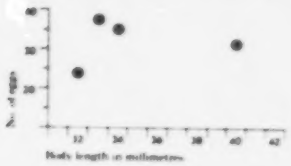
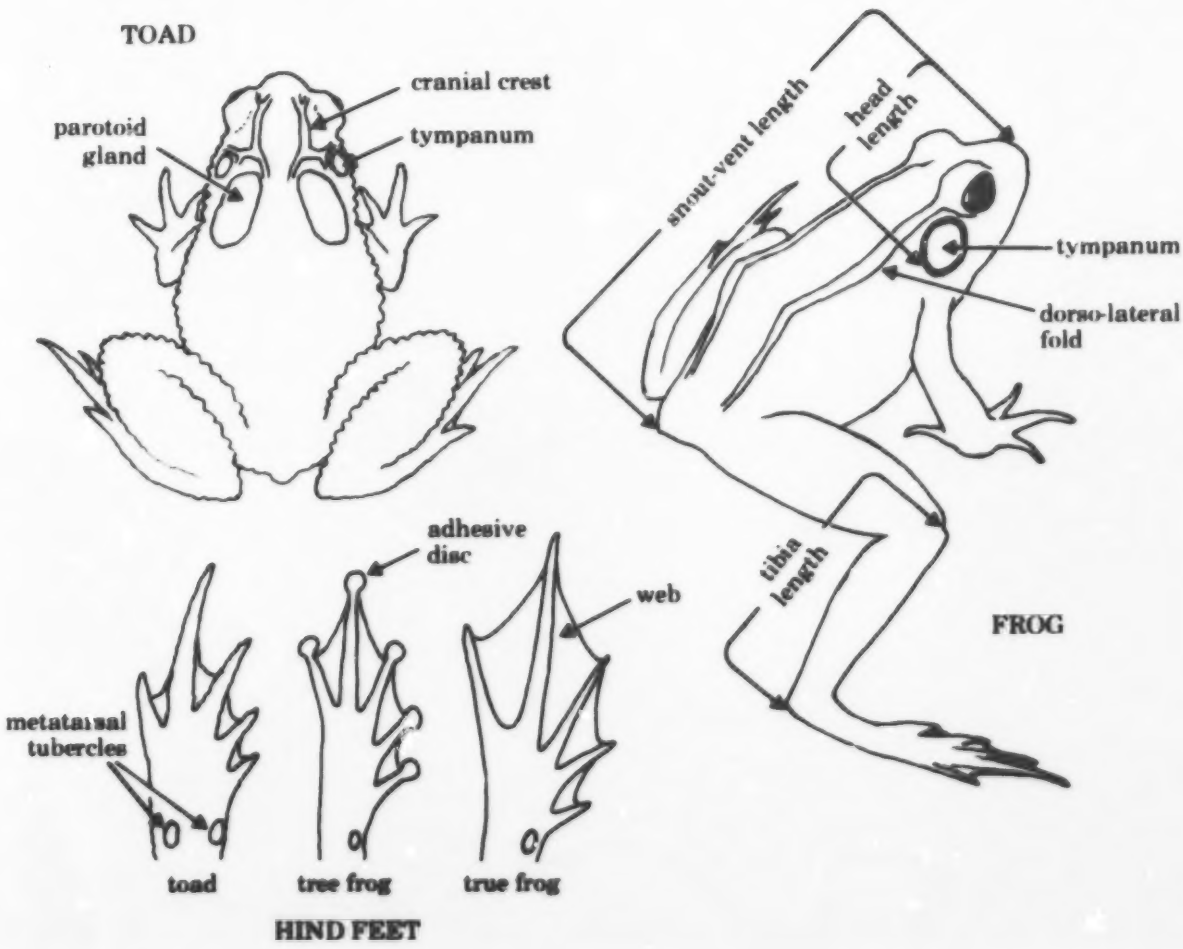


Figure 58.

Four-toed Salamander nesting sites at the base of standing dead conifers at Croskill Lake, Annapolis County, on April 27, 1976

Figure 61.

External characteristics and methods of measuring frogs



Frogs

Order: Anura

The toads, treefrogs and typical or "true" frogs collectively are known as frogs and belong to this order of tail-less amphibians. There are 23 families, comprising 2,770 species of frogs, recognized in the world today. Of the five families that dominate the order, three, the toads (Bufonidae), the treefrogs (Hylidae) and the typical frogs (Ranidae), are represented in the Maritime Provinces.

Frogs have a compact body and the large head is not separated from the trunk by a neck. They have short forelegs and longer, more muscular, hind legs which are used for swimming and jumping. Frogs have movable eyelids and glands to keep the eyes moist. They have a tympanic membrane on each side of the head behind the eye (Figure 61), which transmits vibrations from the air to the inner ear. Frogs also have a true voice box. The males of most species have inflatable vocal sacs. The toads and treefrogs have a single sac in the region of the throat (Figure 62) while most of the typical frogs have a lateral vocal sac on each side, between the limbs (Figure 63). Most species have an extensible tongue for catching prey.

Frogs in the Maritime Provinces congregate in aquatic habitats during the spring and early summer to spawn. The males arrive at suitable

Figure 62.

An adult male Northern Spring Peeper vocalizing in vegetation at the margin of a roadside pond at Colpton, Lunenburg County, at 2120 hrs on April 28, 1975

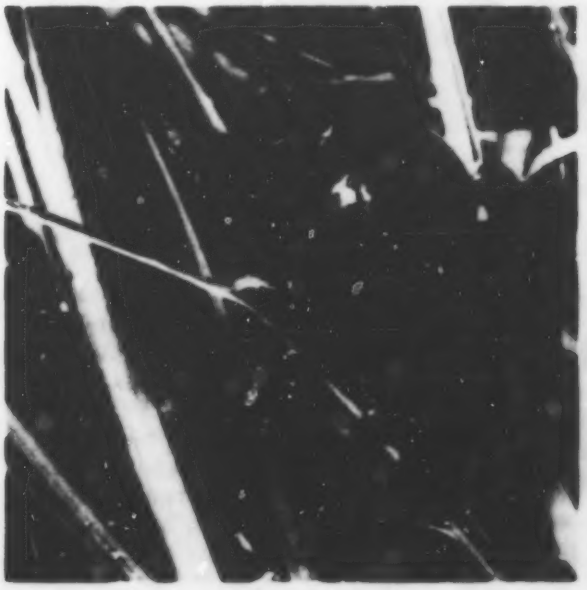


Figure 63.

An adult male Wood Frog vocalizing from the surface in the shallows of a roadside pond, Little Tidnish River area, Cumberland County, at 2200 hrs on April 27, 1975

egg-laying sites first and begin calling a mate. The nuptial call of each species is different. Recognizing the distinct voice of the male of her own kind, the silent female migrates to the breeding site. The male then climbs "piggy-back" on the female (a position called amplexus) and spawning usually takes place shortly thereafter. The male fertilizes the eggs as they are extruded by the female.

Frog eggs develop rapidly and the hatching tadpoles or polliwogs of most species transform into young frogs within three to four months. The hind legs are visible first. When the front legs have developed there is a period of fasting as the tadpole must now change from a small-mouthed scavenger or herbivore to a large-mouthed predator. During the period of fasting the tail is absorbed, not shed. Since most frogs are less secretive than the salamanders, they are more vulnerable to predation. Frog eggs provide food for a number of aquatic animals. On a number of occasions I have observed predation on tadpoles by predacious diving beetles and their aggressive larvae, called water tigers (*Dytiscus verticallis*), large dragonfly nymphs (*Cordulegaster diastatops*), leeches (*Macrobdella decora*) and Maritime Garter Snakes. The common Snapping Turtle, Blanding's Turtle and Eastern Painted Turtle are known to eat frog tadpoles. On two occasions in early August, 1976, at Simpson Lake, Colchester County, an American Robin (*Turdus migratorius*), was observed feeding on Eastern American Toad polliwogs which were crowded in the shallows. At 1820 hrs on August 3 and 0730 hrs on August 4, 1980, a Great Blue Heron (*Ardea herodias*), was observed feeding on legged tadpoles and transformed Mink Frogs in a slow, silty-bottomed vegetated stream at Chapman Settlement, Cumberland County. Frogs are food for a wide variety of animals, including leeches, fish, reptiles, birds and mammals. Snakes are probably the most important predator on frogs. Also, frogs are killed by automobiles on roads during rainy nights in spring, summer and autumn. It is interesting to note as well that I have observed cannibalism of tadpoles by adult Bullfrogs and Green Frogs. Bleakney (1958) observed cannibalism by Wood Frog tadpoles.

Herpetologists take two basic measurements of frogs: the body length (or snout-vent length) and tibia length (Figure 61). The tibia length can then be divided by the body length to establish the tibia/body ratio. The data from a particular species in one region can be compared with the data for the same species obtained from other regions throughout its range in North America.

Taking colour notes of frogs should be done as soon after capture as possible, because frogs can change their colour and alter their pattern rapidly when removed from their natural habitat.

Some herptelogists count the number of large oval spots between the dorso-lateral folds (Figure 61) on Northern Leopard Frogs and also the large irregular rectangular spots on Pickerel Frogs. They may also count the number of elongate spots on the tibia and tarsus and note how many of these spots line up to form a band across the leg when the frog is in a natural resting or sitting position.

Toads

Family Bufonidae

The family Bufonidae consists of 279 species and is represented in the Maritime provinces by the Eastern American Toad.

Compared to the treefrogs and the typical frogs, toads have a stout body and short legs and their skin is dry and warty. Toads have prominent conified tubercles, called metatarsal tubercles, on their hind feet (Figure 61), which are used in shoving the soil beneath them to the sides so that they gradually sink and even bury themselves.

Most North American toads, including the four species found in Canada, have large shoulder glands, called parotoid glands (Figure 61), and three of these species have raised bony ridges on the head, called cranial crests (Figure 61). The shape of the parotoid glands, the structure of the cranial crests, the number of warts in the dorsal spots and the amount of spotting on the underside are important characteristics that herpetologists use in recognizing the various species of toads.

Toads are popularly called hop toads because they tend to move about in a series of short hops rather than extended leaps like other frogs.

People do not get warts from handling toads. However, the tubercles and parotoid glands do contain a poisonous secretion which is white, very sticky and is toxic to some animals.

Eastern American Toad

Bufo americanus americanus Holbrook

Variation

COLOUR

The Eastern American Toad varies in ground colour on the back and sides. In general colour, most individuals are a shade of brown, with the tubercles on most of the back being a darker shade than the rest of the skin. Some individuals, particularly males, are almost uniform orange-brown, khaki-green, yellowish-grey or black. The groin region of some brown females is orange-red, while the groin and lower back of some black males is red. Most individuals have a pale brown stripe down the middle of the back. The underside is greenish-white or brownish-white and, with the exception of those from the greater Annapolis Valley area, most individuals have two-thirds or more of the abdomen pigmented with black spots or reticulations. The spots may be small and indistinct or comparatively large and prominent, and can be numerous or few. Many individuals in the greater Annapolis Valley area, and uncommonly in other areas of the province, have less than two-thirds of the abdomen spotted. Rarely, an individual completely lacks abdominal spotting or has a little dark pigment in the pectoral region only. During the breeding season the throat on males is very dark, almost black.

LENGTH OF ADULTS

The body length of 205 breeding males ranged from 49 to 76.2 mm, while that of 55 females ranged from 57.2 to 104.8 mm (Figure 64). The tibia represented from 36.3 to 47.4 per cent of the body length in 185 of these males and from 34.1 to 43.7 in 48 of the females (Table 11).

Distribution

In Canada the Eastern American Toad ranges from Newfoundland (where it was introduced in 1960) as far west as eastern Manitoba (where it hybridizes with the Canadian Toad, *Bufo a. hemiophrys*) and reaches as far north as Ungava Bay, James Bay and possibly Hudson Bay. Its range covers most of the eastern United States as far south as Mississippi and west to northeastern Kansas. In Nova Scotia the Eastern American Toad is widespread throughout the province (Figure 65).

Figure 64.

Body length measurements in millimetres of 260 adult Eastern American Toads from Nova Scotia (205 males and 55 females)

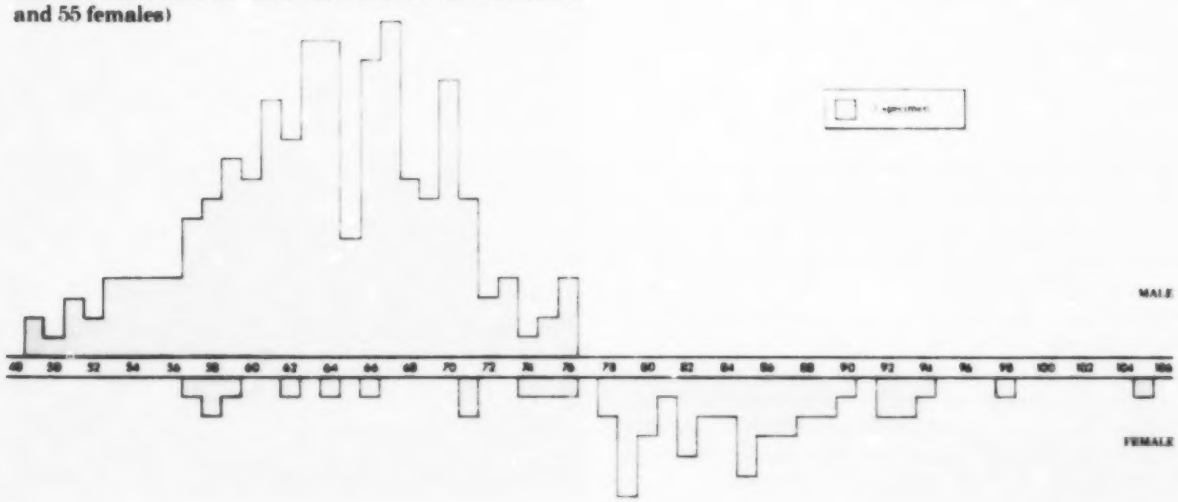


Table 11:
Length measurements in millimetres of 260 adult Eastern American Toads from Nova Scotia

No. of Individuals, Sex, Recorder, Years collected	Body Length Range (Mean)	Tibia/Body Ratio Range (Mean)
20 males J. S. Bleakney, 1950	60.3-76.2 (68.2)	
185 males J. Gilhen, 1969-1981	49.0-76.0 (62.8)	.363-.474 (.414)
7 females J. S. Bleakney, 1950	57.2-104.8 (73.8)	
48 females J. Gilhen, 1969-1981	58.0-98.0 (82.2)	.341-.437 (.388)

Figure 65.

Distribution of the Eastern American Toad in Nova Scotia

Habitat

The Eastern American Toad is common along the shores of ponds, lakes and streams and in adjacent woodlands. This toad is so flexible in its habitat requirements that it can be expected to occur in most terrestrial situations, including forest, both coniferous and deciduous, agricultural areas, suburban areas and a host of disturbed habitats such as gravel pits and cut-over areas. It is the most commonly observed frog in towns because it frequents backyard gardens and front lawns and will often remain in such places throughout the summer.

Natural History

Eastern American Toads move out from their subterranean places of hibernation during the spring. The earliest record is April 5, 1960, when two adult females were collected in the town of Wolfville, Kings County.

The breeding season reaches its height during May and early June. At this time the melodious trilling call of the males can be heard coming from the immediate shallows or margins of lakes and streams, and most permanent and temporary ponds throughout the countryside (Figure 66).

Upon reaching the breeding site one of the males mounts the female. The female, transporting the male in amplexus, moves about the shallows laying her eggs in paired string-like strands over the bottom. Based on the egg counts of 28 females, each female produces between 1,689 and 12,094 eggs each year, depending mostly on her body size. Most females produce between six and 12 thousand eggs (Figure 67).

The polliwogs usually crowd in the warm shallows (Figure 68), where they develop rapidly and

Figure 66.

An adult male Eastern American Toad vocalizing in the vegetated shallows of a roadside pond at Baddeck, Victoria County, at 2130 hrs on May 14, 1975

Figure 67.

Number of ovarian eggs in relation to body length in 28 female Eastern American Toads from Nova Scotia

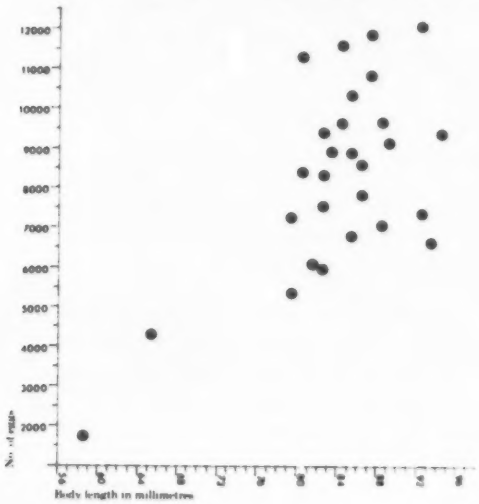
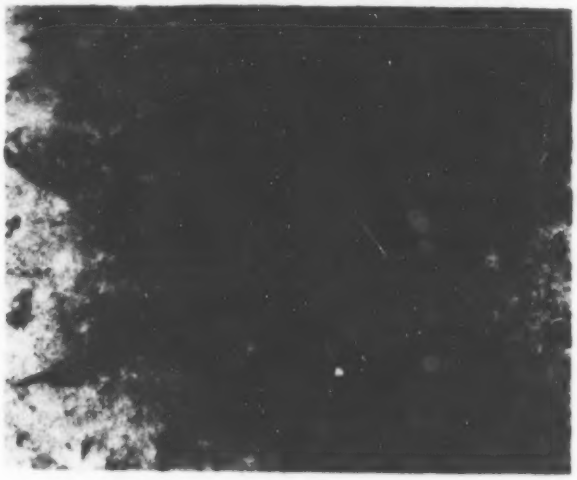


Figure 68.

Eastern American Toad polliwogs on the bottom of a shallow roadside pond at Cross Roads Country Harbour, Guysborough County, at 1515 hrs on June 27, 1978



transform into young toads from July through September.

Juvenile and adult Eastern American Toads prey heavily on ants, beetles (particularly snout and ground beetles) and spiders, but mites are also favoured by the young or small juveniles. Adults, in particular, also swallow sand, gravel, bits of bark, leaf litter, grass, moss as well as spruce and fir needles, along with their food. A few individuals apparently eat their own shed skin. This species, however, feeds on a great variety of invertebrates.

From the stomachs of 142 individuals the following prey have been identified:

sowbugs (Isopoda)
millipedes (Diplopoda)
centipedes (Chilopoda)
harvestmen (Phalangida)
mites (Acarina)
spiders (Araneida)
springtails (Collembola)
mayflies (Ephemeroptera)
crickets (Gryllidae)
stink bug (Pentatomidae)
damsel bug (Nabidae)
shield-backed bug (Scutelleridae)
spittlebug (Cercopidae)
leafhopper (Cicadellidae)
ground beetles (Carabidae)
hister beetle (Histeridae)
carrion beetle (Silphidae)
rove beetle (Staphylinidae)
fireflies (Lampyridae)
click beetles (Elateridae)
ladybird beetles (Coccinellidae)
scarab beetle (Scarabaeidae)
leaf beetles (Chrysomelidae)
snout beetles (Curculionidae)
bark beetles (Scolytidae)
moth larvae (Lepidoptera)
noctuid moth larvae (Noctuidae)
fly larvae (Diptera)
crane flies (Tipulidae)
midges (Chironomidae)
muscid flies (Muscidae)
braconid wasp (Braconidae)
ichneumon wasp (Ichneumonidae)
ants (Formicidae)
hornet (Vespinae)
bumble bee (Apidae)
earthworms (Oligochaeta)
slug (*Phylomycus carolinianus*)
snails (*Cochlicopa lubrica*, *Hygromia hispida*, *Succinea ovalis* and *Trichia hispida*)

Some individuals from the Harper Lake and Ohio areas, Shelburne County, were parasitized by nematodes (parasitic worms) attached to the lining of the stomach.

The Eastern American Toad is one of the last amphibians to retire to hibernating sites during the autumn. I have often observed individuals on the highway during rainy nights in early November. The latest observation is November 28, 1972, when an adult female was seen by Roy Gilkie in his backyard at Melville Cove, Halifax County.

Treefrogs

Family Hylidae

The treefrog family consists of 30 genera including 395 species. Two species of the genus *Hyla*, the Spring Peeper, *Hyla crucifer*, and the Tetraploid Gray Treefrog, *Hyla versicolor*, represent the treefrog family in the Maritime Provinces.

Treefrogs are distinguished from the other Nova Scotian frogs by their long legs, slim waists and the adhesive discs on each toe (Figure 61). The discs aid treefrogs when climbing about on vegetation or other surfaces. Some species are able to change colour, from brown or grey to green, depending on habitat conditions. Most species are arboreal (tree-dwelling) but some species inhabit low bushes, grasslands and the margins of aquatic habitats.

Most species of treefrogs are native to the tropics. This family, however, is widespread through North, Central and South America as well as in Asia, Europe, Australia, New Guinea and Africa.

The Spring Peeper is a complex of two subspecies: the Northern Spring Peeper, *H. c. crucifer*, which has an unspotted underside, is widespread throughout most of the species' range, including the Maritime Provinces; the Southern Spring Peeper, *H.c. bartramiana*, has a spotted underside and is native to southern Georgia and northern Florida. In the Maritime Provinces, the Tetraploid Gray Treefrog is known with certainty only from one locality in New Brunswick.

Northern Spring Peeper

Hyla crucifer crucifer Weid

Variation

COLOUR

Northern Spring Peepers are extremely variable in colour and pattern. They are usually a shade of brown or grey on the back and sides. The sides of the head always have a dark stripe, from the snout to the tympanum, and on the back of the legs there are dark bands or spots. There is a shallow v-shaped pattern on the back of the head, between the eyes, usually preceded by a dark spot between the nares. This treefrog gets its specific name, *crucifer*, from the dark x-shaped pattern on the back. This marking is common in southern populations but in the Maritime Provinces is usually distorted or fragmented and connected to additional markings. The underside is yellowish-white on brown individuals and greyish-white on grey ones. During the spring the throat of adult males is black or dark brown, flecked with light yellow.

LENGTH OF NEWLY TRANSFORMED YOUNG

The body length of 19 newly transformed young ranged from 13.5 to 14.5 mm. The tibia represented from 46.4 to 51.7 per cent of the body length of these young (Table 12).

LENGTH OF ADULTS

The body length of 492 breeding males ranged from 20 to 33 mm while that of 139 females ranged from 27 to 37 mm (Figure 69). The tibia represented from 41.5 to 52.5 per cent of the body length of 466 of these males and from 41.5 to 50.0 per cent in 139 of the females (Table 12).

Figure 69.

Body length measurements in millimetres of 631 adult Northern Spring Peepers from Nova Scotia (492 males and 139 females)

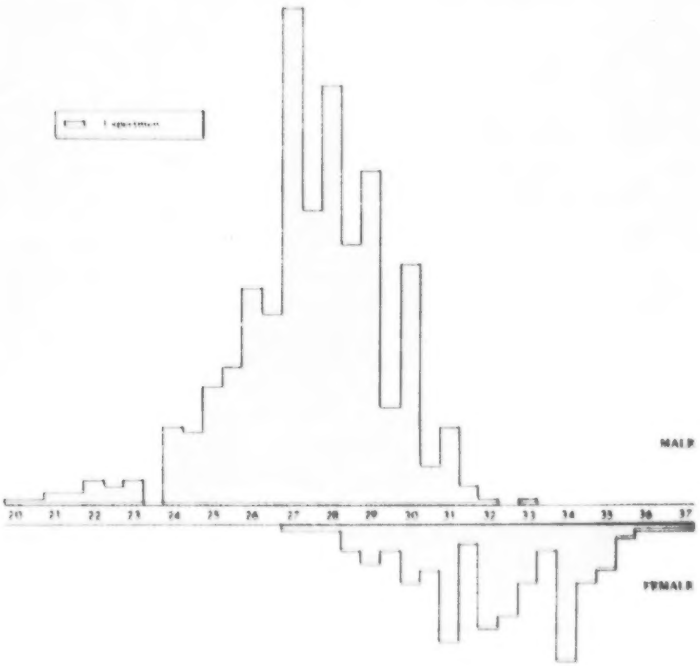


Table 12:
Length measurements in millimetres of 650 Northern Spring Peepers from Nova Scotia

No. of Individuals, Sex, Recorder, Years collected	Body Length Range (Mean)	Tibia/Body Ratio Range (Mean)
19 newly transformed young J. Gilhen, 1980	13.5-14.5 (14.1)	.464-.517 (.478)
27 adult males J. S. Bleakney, 1950	25.4-31.8 (27.8)	
465 adult males J. Gilhen, 1969 to 1981	20.0-33.8 (27.4)	.415-.525 (.462)
139 adult females J. Gilhen, 1969 to 1981	27.0-37.0 (32.2)	.415-.500 (.454)

Figure 70.

Distribution of the Northern Spring Peeper in Nova Scotia

Distribution

In Canada the Northern Spring Peeper ranges from Nova Scotia to eastern Manitoba and in the United States it extends south to northern Florida and west to eastern Texas. In Nova Scotia it is common in all regions of the province (Figure 70).

Habitat

The Northern Spring Peeper inhabits the coniferous, deciduous and mixed woodlands adjacent to ponds, lakes and streams. They are particularly common in the woodlands adjacent to roadside ponds. They will often move to shrubs in suburban gardens.

Natural History

Northern Spring Peepers move to the surface from their subterranean places of hibernation early in spring. The earliest record is March 22, 1983, when five adult males were found on wet pavement during a light rain at 2030 hrs at Forties Settlement area, Lunenburg County.

Figure 71.

A pair of Northern Spring Peepers in amplexus in the vegetated shallows of a roadside pond at Northeast Margaree, Inverness County, at 2230 hrs on May 14, 1975

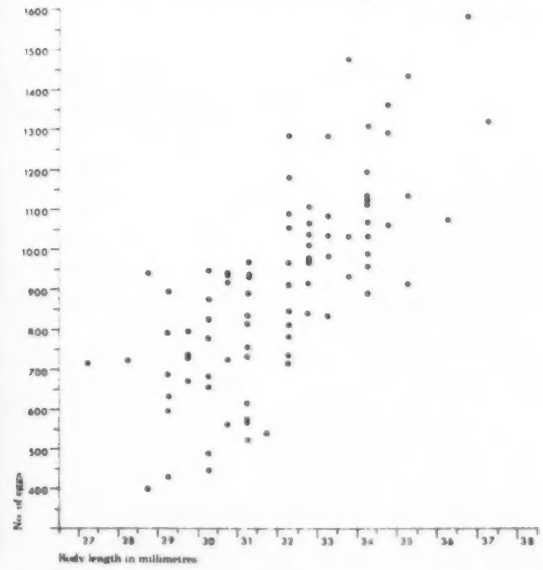
The breeding season extends from early April to early June. During this time the males, which seem to far outnumber the females, migrate to aquatic breeding sites and begin calling for a mate. Their call is a repetitive *peep-peep-peep*. During April they are vocal within the hummocks of grasses and sedges at the margin of the breeding site (Figure 62). They gradually retreat underneath the stems and leaves if the temperature drops during the night. In May, during the height of the breeding season, deafening choruses of these small treefrogs can be heard throughout the countryside. On these mild, balmy nights they are more easily seen by using a flashlight, because many of them spread out and vocalize in open places along the shoreline.

On arriving at the aquatic breeding site the female is mounted by a male and dives to the bottom to deposit her eggs. The eggs are laid individually among the vegetation and debris, such as twigs and leaf litter. The female rises to the surface occasionally for air (Figure 71). Based on the egg counts of 87 females, Northern Spring Peepers produce from 396 to 1,581 eggs each year (Figure 72).

After spawning the male and female separate and move back to woodland habitats. Many males continue to call as they gradually disperse. At this

Figure 72.

Number of ovarian eggs in relation to body length in 87 female Northern Spring Peepers from Nova Scotia



time they can be heard vocalizing from the lower branches of young trees or shrubs as high as a metre or more off the ground (Figure 73). Some males are heard calling occasionally during the day throughout the summer and autumn. For example, several males were heard calling from wild rosebushes alongside cottages at Amherst Shore, Cumberland County, during the morning and afternoon, September 3, 1977. Another male was vocalizing from the doorstep of one cottage.

The tadpoles develop rapidly and transform from July through September.

This treefrog feeds mostly on soft-bodied invertebrates. Small spiders are the most important prey but moth larvae and water midges are commonly eaten. They also swallow bits of vegetation, particularly seeds, and some sand along with their food. From the stomachs of 150 individuals the following prey have been identified:

harvestman (Phalangida)
mite (Acarina)
spiders (Araneida)
water striders (Gerridae)
damsel bug (Nabidae)
leaf hopper (Cicadellidae)
rove beetle (Staphylinidae)
click beetle (Elateridae)
wingless scorpion fly (Mecoptera)
tiger moth larva (Arctiidae)
noctuid moth larvae (Noctuidae)
midges (Chironomidae)
ant (Formicidae)
worm (Nematomorpha)
snail (Zonitidae)

Figure 73.

A male Northern Spring Peeper vocalizing from a shrub about 20 metres from a tributary of Acacia Brook, Digby County, at 2120 hrs on May 9, 1979

The latest observation was on the night of November 5, 1982 when one freshly killed juvenile was found on the road at Forties Settlement area, Lunenburg County.

Typical Frogs

Family Ranidae

The family Ranidae consists of 45 genera and 586 species and is nearly worldwide in distribution. The genus *Rana* is represented in the Maritime Provinces by six species in New Brunswick and Nova Scotia, three of which also occur on Prince Edward Island.

The typical frogs generally have a smooth skin compared to toads. They have long legs. The toes on the front legs are unwebbed, while the toes on the hind legs are connected by a web (Figure 61). Some species, including those found in the Maritime Provinces, except the Bullfrog, have raised folds, called dorso-lateral folds, along each side of the back (Figure 61).

Breeding males can be distinguished from females by the swollen base of the thumbs on the forelegs. Males and females of some species differ in colour and in the diameter of the tympanum, or external eardrum.

Rarely, a Bullfrog, Green Frog or Northern Leopard Frog is found which is partially blue instead of green. The green colour is a combination of structural blue and a yellow pigment. When the yellow is absent the result is blue.

Bullfrog

Rana catesbeiana Shaw

Variation

COLOUR

Mature males are almost uniform in colour on the back. The head is plain green, changing to yellowish-green on the trunk. The legs, however, are yellowish-green with varying amounts of brown spotting. The throat is yellow and the remainder of the underside is pale yellowish-white. Mature females tend to be darker than males and have a pattern of brown spots on the back and bands on the hind legs. The underside is yellowish-white mottled with grey.

One adult female collected from the deep, silty bottom of a boggy tributary of Acacia Brook, Digby County, on May 9, 1979 was black on the back; but after several hours in captivity at room temperature the colour changed to normal. One sub-adult female from Medway River, Queens County, was largely sky blue on the back and is illustrated on colour plate no. _____.

LENGTH OF NEWLY TRANSFORMED YOUNG

The body length of 31 newly transformed young ranged from 44 to 54 mm. The tibia represented from 42.6 to 49 per cent of the body length of these young (Table 13).

LENGTH OF ADULTS

The body length of 17 breeding males ranged from 101 to 147.9 mm while that of 10 females ranged from 102 to 133.4 mm (Figure 74). The tibia represented from 42.9 to 47.1 per cent of the body length of 11 of these males and from 41.3 to 47.1 in eight of the females (Table 13).

Distribution

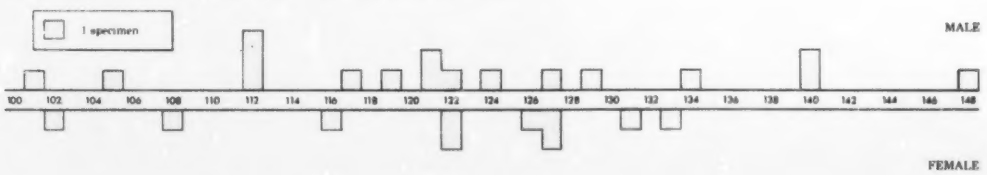
In Canada Bullfrogs are found in mainland Nova Scotia, southern New Brunswick, southern Quebec and southern Ontario. (There are several populations in southern British Columbia which were established as a result of introductions). In the United States the range of the Bullfrog extends far south to central Florida and as far west as the Rocky Mountains. Conant (1975) said the natural

Table 13:
Length measurements in millimetres of 58 Bullfrogs from Nova Scotia

No. of Individuals, Sex, Recorder, Years collected	Body Length Range (Mean)	Tibia/Body Ratio Range (Mean)
31 newly transformed young J. Gilhen, 1968-1973	44.0-54.0 (48.5)	.426-.490 (.454)
6 adult males J. S. Bleakney, 1950	104.8-147.9 (127.3)	
11 adult males J. Gilhen, 1969-1979	101.0-140.0 (119.9)	.429-.471 (.450)
2 adult females J. S. Bleakney, 1950	108.0-133.4 (120.7)	
8 adult females J. Gilhen, 1969-1979	102.0-131.0 (121.6)	.413-.471 (.436)

Figure 74.

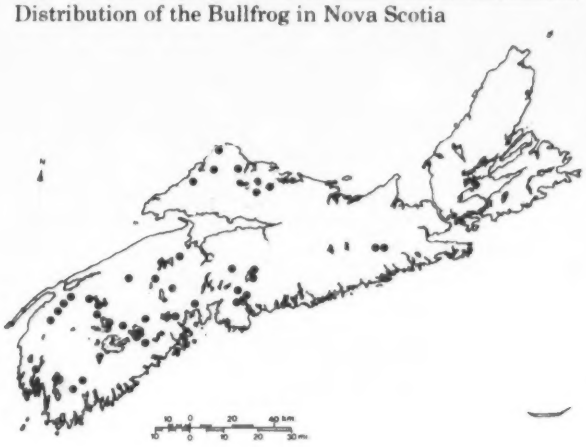
Body length measurements in millimetres of 27 adult Bullfrogs from Nova Scotia (17 males and 10 females)



western limits of this species were hopelessly confused because of introductions into a vast number of localities. Bullfrogs have also been introduced into Mexico, Cuba and Jamaica. In Nova Scotia Bullfrogs are common in the Cumberland lowlands and inland from the spruce-fir coast of the southern mainland. They are common at a few localities in the St. Mary's River watershed and probably occur in a few other local pockets northeast of Halifax. There are no records from Cape Breton Island (Figure 75).

Figure 75.

Distribution of the Bullfrog in Nova Scotia



Habitat

Bullfrogs are common in ponds, the quiet coves of lakes, and in boggy stretches of streams where there is an abundance of vegetation, particularly water lilies.

Natural History

Bullfrogs are the last amphibians to emerge from hibernation in spring. Apparently the first to become active are the overwintering tadpoles, followed by the juveniles and then the adults. The earliest record for tadpoles is April 10, 1951, when two were collected at Caledonia, Queens County. The earliest record for juveniles is April 15, 1972 when one was collected at Colpton, Lunenburg County, and the earliest record for an adult is May 4, 1983 when an adult female was captured at New Grafton, Queens County.

The breeding season extends from mid June throughout July but individual males have been

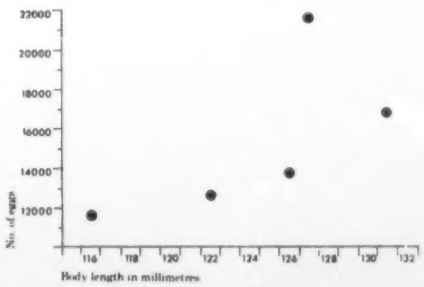
Figure 76.

An adult male Bullfrog vocalizing on the surface of a lily pond in a gravel pit adjacent to Wallace River, Wentworth Centre, Cumberland County, at 2100 hrs on June 12, 1978

heard vocalizing earlier in the season. At this time the males move out from shore and settle among the water lilies where their loud booming bass call, commonly described as "jug-o'-rum", can be heard throughout the night (Figure 76). Spawning takes place soon after the female is grasped by a male. She extrudes her eggs in a huge, film-like mass on the surface among the water lilies. Based on the egg counts of five females, Bullfrogs produce from 11,585 to 21,510 eggs each year (Figure 77).

Figure 77.

Number of ovarian eggs in relation to body length in five female Bullfrogs from Nova Scotia



The tadpoles take two years to develop into young Bullfrogs. After two winters, hibernating in the deep silt bottom under their ice-covered habitat, they have well-developed hind legs. Based on the measurements of 24 individuals from Fish Lake, Halifax County, these tadpoles reach a total length of from 122 to 149 mm. This combined body and tail length range equals the body length of the largest adults.

Often when the newly transformed individuals are approached by humans they let out a squeak as they dive from the edge of the pond into the water. When captured and held by the hind legs some adults will open their mouths and let out a startling scream.

Bullfrogs feed on a great variety of animal life, and inadvertently take in gravel and vegetation. One individual had eaten a feather shed from a small bird. Spiders and terrestrial and aquatic insects are important food for the young, but as they mature they will eat practically any animal which they can swallow, including small birds and mammals. Their own tadpoles and small juveniles as well as the tadpoles and juveniles of the Green Frog are important prey of adults. I have observed on a number of occasions the adults waiting on a bank for tadpoles and aquatic insects and their nymphs to rise to the surface, and then jumping in to catch and swallow these prey. From the stomachs of 115 individuals the following prey have been identified:

sowbugs (Isopoda)
millipedes (Diplopoda)
mite (Acarina)
spiders (Araneida)
mayflies (Ephemeroptera)
dragonfly nymphs and adults (Odonata)
damselfly nymphs and adults (Odonata)
stonefly nymph (Plecoptera)
backswimmers (Notonectidae)
water striders (Gerridae)
stilt bug (Berytidae)
spittlebugs (Cercopidae)
alderfly (Sialidae)
tiger beetle (Cicindelidae)
ground beetles (Carabidae)
predaceous diving beetle larvae and adults (Dytiscidae)
whirligig beetles (Gyrinidae)
water scavenger beetles (Hydrophilidae)
carrion beetle (Silphidae)
rove beetle (Staphylinidae)
click beetles (Elateridae)
June bugs (Scarabaeidae)
long-horned beetle (Cerambycidae)
leaf beetles (Chrysomelidae)
snout beetles (Curculionidae)
caddisfly (Trichoptera)
tent caterpillar (Lasiocampidae)
tiger moth larvae (Arctiidae)
noctuid moth larvae (Noctuidae)
tortricid moth larvae (Tortricidae)
craneflies (Tipulidae)
midge larvae and adults (Chironomidae)
ants (Formicidae)
bumble bees (Apidae)
earthworms (Oligochaeta)
slugs (*Arion* sp.)
snails (*Zonitoides* sp., *Lymnaea columella* and *Succinea ovalis*)
Ninespine stickleback (*Pungitius pungitius*)
Red-spotted Newt adults
Eastern American Toad
Northern Spring Peeper
Bullfrog tadpoles and young
Green Frog tadpoles and young

The stomachs of many individuals from the south-central mainland of Nova Scotia were parasitized by nematodes (parasitic worms).

Bullfrogs apparently retire to the silty bottom of their aquatic habitat by late summer. The latest recorded collection is August 24, 1950, when tadpoles were collected at Wigmore Lake, Cumberland County, and August 23, 1970, when one juvenile was collected at Tomahawk Lake, Halifax County. Adults and juveniles, however, are probably active in early September in the south-central mainland.

Green Frog

Rana clamitans melanota (Rafinesque)

Variation

COLOUR

Green frogs are variable in colour. In mature males the chin is always bright yellow and the rest of the underside is greyish-white washed with variable amounts of yellow. Some males are almost uniformly green above, with yellow on the lower sides; with the exception of the yellow chin, many other males are as variable as the females. Mature females have a green head. The back is brownish-bronze with dark brown spots. The dark spots on the back of the legs are elongate. The underside varies from greyish-white to enamel-white mottled with grey on the chin and legs.

Some males, particularly individuals in shaded woodland ponds (Figure 78), are black on the back (Figure 79). Three males, one from Sherbrooke Lake area, Lunenburg County, one from Garden of Eden, Pictou County and one from Minard Brook, Queens County, were dark metallic blue on the back and head.

LENGTH OF NEWLY TRANSFORMED YOUNG

The body length of 37 newly transformed young ranged from 28 to 39 mm. The tibia represented from 43.3 to 55.8 per cent of the body length of these young (Table 14).

LENGTH OF ADULTS

The body length of 91 adult males ranged from 69.9 to 98.4 mm while that of 68 adult females ranged from 67 to 108 mm (Figure 80). The tibia represented from 47.4 to 52.9 per cent of the body length of 30 of these males and from 44.8 to 54.7 per cent in 16 of the females (Table 14).

Table 14:
Length measurements in millimetres of 196 Green Frogs from Nova Scotia

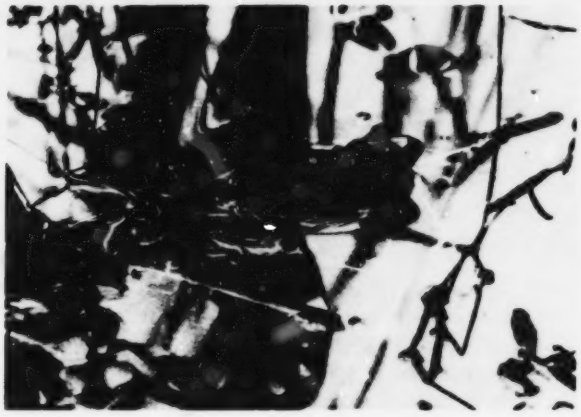
No. of Individuals, Maturity, Sex, Recorder, Years collected	Body Length Range (Mean)	Tibia/Body Ratio Range (Mean)
37 newly transformed young J. Gilhen, 1972-1978	28.0-39.0 (33.2)	.433-.558 (.504)
59 adult males J. S. Bleakney, 1950	69.9-98.4 (82.2)	
2 adult males J. L. Martin, 1951	75.0-78.0 (76.5)	
30 adult males J. Gilhen, 1939-1980	70.0-89.0 (79.2)	.474-.529 (.500)
46 adult females J. S. Bleakney, 1950	68.3-108 (80.3)	
6 adult females J. L. Martin, 1951	67.0-84.0 (77.8)	
16 adult females J. Gilhen, 1969-1980	72.0-85.0 (78.8)	.448-.547 (.498)

Figure 78.

A shaded woodland pond near Little Gammon Lake, Halifax County, where 10 male Green Frogs were vocal on July 17, 1980

Figure 79.

A black male Green Frog vocalizing in the shallows of a shaded woodland pond near Little Gammon Lake, Halifax County, at 0900 hrs on July 17, 1980



DORSOLATERAL RIDGES

The dorsolateral ridges are distinct and extend almost the entire length of the trunk. Often the ridges are interrupted in one or more places just before they terminate.

Habitat

Green Frogs are common in lakes, ponds and streams. Practically any body of fresh water is potential habitat for this species, whether it is small or large, temporary or permanent, and with or without aquatic vegetation.

Distribution

In Canada Green Frogs are found from the Maritime Provinces west to the Ontario-Manitoba border, but this species has been successfully introduced to scattered localities in Newfoundland and also in southwestern British Columbia. In the United States Green Frogs range south to North Carolina and west to Minnesota and Oklahoma, but are absent from most of Illinois. This species has also been successfully introduced into the states of Washington and Utah. In Nova Scotia Green Frogs are widespread throughout the mainland and Cape Breton Island (Figure 81).

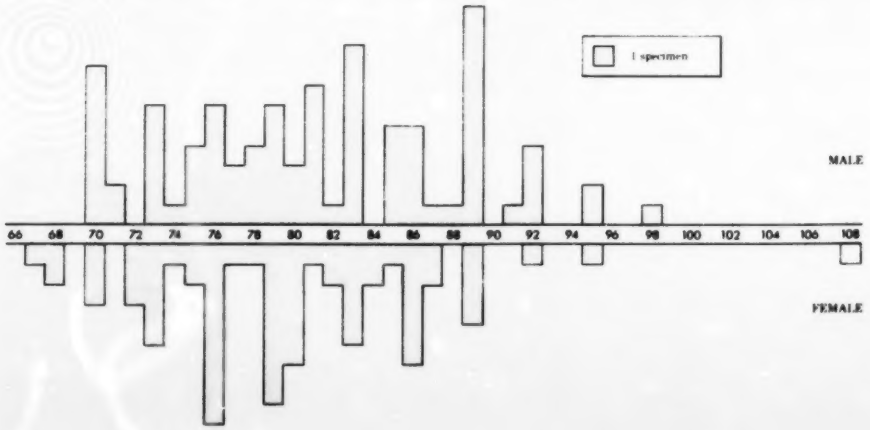
Natural History

Green Frogs surface from the bottom of their aquatic places of hibernation during spring. The earliest record for tadpoles is April 16, 1975, at Colpton, Lunenburg County, and the earliest record for adults is May 1, 1980 at Apple River, Cumberland County.

The breeding season extends from early June throughout July. At this time the males spread out along the shallows, with the larger dominant males challenging other males that attempt to enter the most favourable vegetated spawning sites. The voice of the male, which sounds something like the twang of a loose banjo string, can be heard

Figure 80.

Body length measurements in millimetres of 159 adult Green Frogs from Nova Scotia (91 males and 68 females)



throughout the day and night, especially during the first hours of daylight. Soon after the male couples with the female, spawning takes place at the surface. The eggs are extruded in a film-like mass among the surface vegetation. Based on the egg counts of 10 females, Green Frogs produce from 1,401 to 5,289 eggs each year (Figure 82).

The tadpoles overwinter underneath the silt and dead vegetation on the bottom of their aquatic habitat and transform the following summer, or about one year after hatching.

Green Frogs feed on a great variety of small aquatic and terrestrial animals. Beetles, bugs, spiders, ants, moth larvae and snails make up the bulk of their food. From the stomachs of 100 Green Frogs the following prey have been identified:

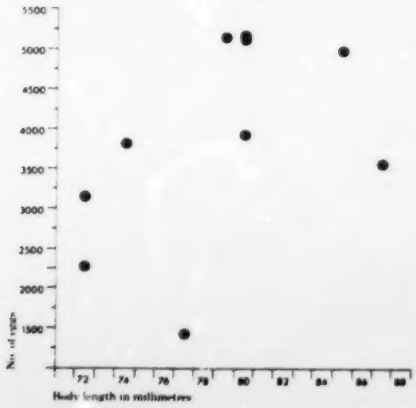
sowbugs (Isopoda)
millipedes (Diplopoda)
centipedes (Chilopoda)
harvestman (Phalangida)
spiders (Araneida)
damselflies (Odonata)
grasshopper (Acrididae)
cricket (Gryllidae)
water boatman (Corixidae)
leaf bugs (Miridae)
lace bugs (Tingidae)
assassin bug (Reduviidae)
stink bug (Pentatomidae)
treehoppers (Membracidae)
spittlebugs (Cercopidae)
leafhoppers (Cicadellidae)
aphids (Aphididae)
ground beetles (Carabidae)
round sand beetles (Omophronidae)
fireflies (Lampyridae)
click beetles (Elateridae)
pill beetles (Byrrhidae)
sap beetles (Nitidulidae)
June beetles (Melolonthinae)
leaf beetles (Chrysomelidae)
snout beetles (Curculionidae)
casebearing moth larvae (Coleophoridae)
geometer moth larvae (Geometridae)
noctuid moth larvae (Noctuidae)
bagworm moth larvae (Psychidae)
craneflies (Tipulidae)
water midges (Chironomidae)
muscid flies (Muscidae)
tachinid flies (Tachinidae)
common sawfly (Tenthredinidae)
braconid wasp (Braconidae)
ichneumon wasp (Ichneumonidae)
chalcid wasps (Chalcididae)
ants (Formicidae)
bumble bee (Apidae)
earthworms (Oligochaeta)
slugs (*Arion* sp)
snails (*Cionella lubrica, Succinea ovalis, Discus cronkhitei, Zonitoides* sp., *Cepaea hortensis*)
Northern Spring Peepers

Figure 81.

Distribution of the Green Frog in Nova Scotia

Figure 82.

Number of ovarian eggs in relation to body length in 10 female Green Frogs from Nova Scotia



At Colpton, Lunenburg County, I observed an adult female Green Frog eating a Green Frog tadpole which it attacked when the tadpole moved to the surface. The stomachs of many individuals from the south-central mainland were parasitized by nematodes (parasitic worms).

Green Frogs move to the bottom of their aquatic habitat early in the autumn to hibernate. The latest date recorded is November 5, 1982, when 11 individuals (10 young of the year and one adult) were collected on wet highway at Forties Settlement area, Lunenburg County.

Mink Frog

Rana septentrionalis Baird

Variation

COLOUR

Mink Frogs are variable in colour and pattern. Conant (1975) narrowed the variation down to a spotted pattern and a mottled pattern. The sides of the head and shoulders are green but the trunk can be mottled with olive-green and brown with or without a few brownish-black spots; irregular shaped green, bronze and black blotches; or green with black spots. The backs of the legs are green with black spots and when the spots are elongate they run down the leg and not across it as on Green Frogs. The underside is greyish-white but may be washed with pale yellow on the lower sides and chin of some individuals.

The back in about half the population at Uniacke Lake, Hants County, is green, bronze and black, and black dominates the pattern on many of them. One individual had a green head, black back and a large bronze blotch on each side. One adult female from Black Duck Lake, Kings County, was green with black vermiculations down the back.

LENGTH OF NEWLY TRANSFORMED YOUNG

The body length of 43 newly transformed young ranged from 28 to 42 mm. The tibia represented from 41 to 51.4 per cent of the body length of these specimens (Table 15).

LENGTH OF ADULTS

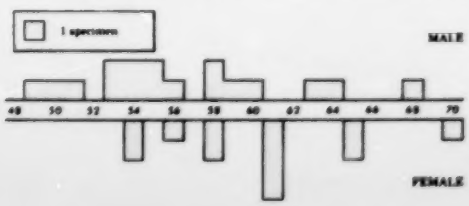
The body length of 17 adult males ranged from 49 to 68 mm while that of 12 females ranged from 53.5 to 70 mm (Figure 83). The tibia represented from 44.2 to 50.9 per cent of the body length of 16 of these males and from 44.3 to 49.5 per cent in 11 of the females (Table 15).

Table 15:
Length measurements in millimetres of 72 Mink Frogs from Nova Scotia

No. of Individuals, Maturity, Sex, Recorder, Years collected	Body Length Range (Mean)	Tibia/Body Ratio Range (Mean)
43 newly transformed young J. Gilhen, 1976	28.0-42.0 (35.9)	.410-.514 (.454)
1 adult male J. S. Bleakney, 1952	64.0	
16 adult males J. Gilhen, 1963-1980	49.0-68.0 (56.3)	.442-.509 (.477)
1 adult female J. S. Bleakney, 1951	70.0	
11 adult females J. Gilhen, 1968-1980	53.5-65.0 (60.1)	.443-.495 (.469)

Figure 83.

Body length measurement in millimetres of 29 Mink Frogs from Nova Scotia (17 males and 12 females)



DORSOLATERAL FOLDS

The dorsolateral folds may be absent or may extend up to two-thirds the length of the trunk. The folds are less prominent than on Green Frogs.

Distribution

In Canada, Mink Frogs range from Nova Scotia and New Brunswick north to Anticosti Island and southern Labrador and west to south-eastern Manitoba. In the United States their range extends south into northwest Maine and New York, and west to northwestern Minnesota. In Nova Scotia they have been found in scattered localities throughout most of the mainland and Cape Breton Island (Figure 84).

Habitat

The main component in Mink Frog habitat is an abundance of aquatic vegetation, particularly lily pads and pickerel weed in ponds, coves of lakes (Figure 85), and quiet stretches of streams (Figure 86).

Natural History

Mink Frogs emerge from hibernation about the middle of spring. The earliest record is May 7, 1968, when a juvenile male was collected at Kejimkujik Lake, Queens County.

The height of the breeding season is in July. At this time the males take their place at suitable spawning sites among the surface vegetation and begin calling a mate. The voice of the male, which

Figure 84.

Distribution of the Mink Frog in Nova Scotia

Figure 85.

Lily Lake, Colchester County, a habitat where Mink Frogs are common

Figure 86.

An island of pickerel weed at Minard Brook, Queens County, a habitat where Mink Frogs, Pickerel Frogs and Red-spotted Newts are common

can be heard during the day and night, is a repeated "cut — cut-cut". When a number of individuals are vocal it sounds like two or more carpenters nailing shingles on a house somewhere in the distance.

Based on the number of eggs counted in seven preserved females, Mink Frogs produce from 986 to 1715 eggs each year (Figure 87). The tadpoles overwinter in their aquatic habitat and transform in July and August, about one year after hatching.

Mink Frogs are extremely timid and if care is not taken not to make a noise when approaching their habitat, all that can be seen is the surface break in a number of places where they seem to skid off the vegetation and take cover underneath. The best time to observe them is at night (Figure 88) as they, like other frogs, tend to remain still when the beam from a flashlight is held on them. When picked up, Mink Frogs immediately give off a rank, musty odour which has been described as smelling like a mink or like rotting onions.

Mink Frogs feed on a variety of aquatic and terrestrial invertebrates, particularly ants, beetles, bugs, moth larvae, spiders and flies. From the stomachs of 90 Mink Frogs the following prey have been identified:

sowbugs (Isopoda)
centipedes (Chilopoda)
spiders (Araneida)
springtails (Collembola)
mayflies (Ephemeroptera)
dragonflies (Odonata)
damselflies (Odonata)
stoneflies (Plecoptera)
water boatman (Corixidae)
water striders (Gerridae)
leaf bugs (Miridae)
shore bugs (Saldidae)
stink bugs (Pentatomidae)
spittle bugs (Cercopidae)
leafhoppers (Cicadellidae)
aphid (Aphididae)
ground beetles (Carabidae)
predacious diving beetles (Dytiscidae)
whirligig beetles (Gyrinidae)
rove beetles (Staphylinidae)
click beetles (Elateridae)
blister beetles (Meloidae)
leaf beetles (Chrysomelidae)
snout beetles (Curculionidae)
caddisflies (Trichoptera)
tiger moth larvae (Arctiidae)
noctuid moth larvae (Noctuidae)
tussock moth larvae (Liparidae)
midges (Chironomidae)
black flies (Simuliidae)
long-legged flies (Dolichopodidae)
muscid flies (Muscidae)
ichneumon wasps (Ichneumonidae)
ants (Formicidae)
slugs (*Arion* sp.)
snails (*Cionella lubrica*, *Discus chronkhitei*, *Pseudosuccinea* sp., Zonitidae and *Fossaria* sp.)

Mink Frogs start to hibernate in the silty bottom of their aquatic habitat between late summer and early autumn. The latest record is September 30, 1924 at Cheticamp Lake, Victoria County.

Figure 87.

Number of ovarian eggs in relation to body length in seven Mink Frogs from Nova Scotia

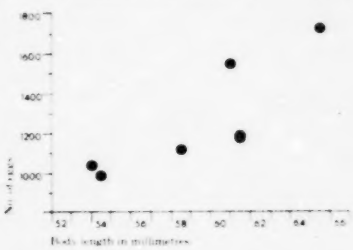
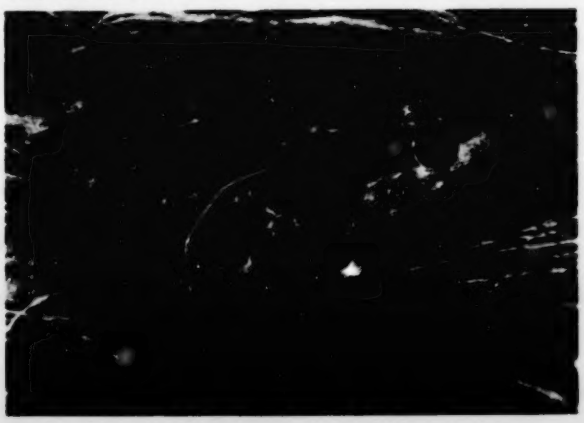


Figure 88.

An adult male Mink Frog vocalizing from the vegetated shallows of Lily Lake, Colchester County, at 2345 hrs on June 12, 1978



Wood Frog

Rana sylvatica Le Conte

Variation

COLOUR

Wood Frogs are variable in colour. During the summer they are usually a shade of greyish-brown or tan-brown with a few dark brown spots on the sides, and sometimes also on the back. These are particularly prominent bordering the lower edge of the dorsolateral folds. The underside is greyish-white and most individuals, particularly males, have variable amounts of grey spotting on the chin and abdomen. The Wood Frog is commonly called the "robber frog" in some areas because of the dark brown mask-like patch which extends along the sides of the head, from the snout to and including the tympanum. During the breeding season, however, all of the males vary from dark greyish-brown to dark chocolate-brown and the mask is obscured. Some females, more commonly in the red sandstone, shale and conglomerate areas of the northern mainland, are reddish-brown, washed with copper green on the groin.

LENGTH OF ADULTS

The body length of 230 males ranged from 38 to 53 mm, while that of 53 females ranged from 48 to 60 mm (Figure 89). The tibia represents from 49 to 61.1 per cent of the body length in 226 of the males and from 50.9 to 62.8 per cent in 50 of the females (Table 16).

DORSOLATERAL FOLDS

The dorsolateral folds are prominent and extend the length of the trunk.

Distribution

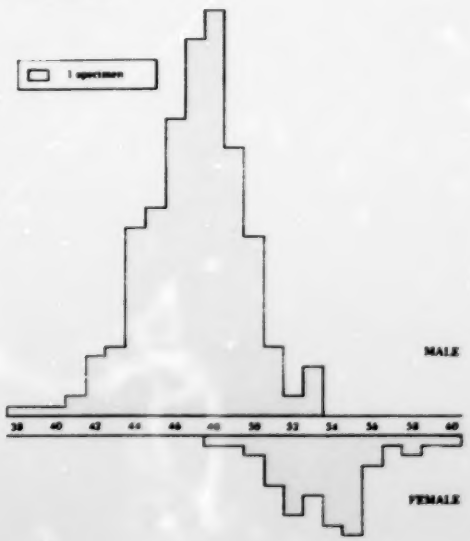
In North America the Wood Frog occurs farther north than any other amphibian or reptile. In Canada it ranges as far as the treeline from Labrador to Yukon Territory. It is not found in the short-grass prairie regions of Saskatchewan and Alberta and in central and southern British Columbia. Along the wooded McKenzie Valley it penetrates the Arctic Circle. In the United States the Wood Frog ranges from Maine west to eastern

Table 16:
Length measurements in millimetres of 283 adult Wood Frogs from Nova Scotia

No. of Individuals, Sex, Recorder, Years collected	Body Length Range (Mean)	Tibia/Body Ratio Range (Mean)
4 males J. S. Bleakney, 1950	44.5-47.6 (45.3)	
226 males J. Gilhen, 1969-1980	38.0-53.0 (46.9)	.490-.611 (.540)
3 females J. S. Bleakney, 1950	50.8-54.0 (51.9)	
50 females J. Gilhen, 1969-1980	48.0-60.0 (53.6)	.509-.628 (.554)

Figure 89.

Body length measurements in millimetres of 276 adult Wood Frogs from Nova Scotia (226 males and 50 females)



North Dakota and south to the southern Appalachians with isolated populations in the central United States. In Nova Scotia the Wood Frog is widely distributed on the mainland and Cape Breton Island (Figure 85). It has been successfully introduced to Newfoundland.

Figure 90.

Distribution of the Wood Frog in Nova Scotia

Habitat

Wood Frogs are found in damp woodlands, particularly in deciduous and mixed woods. They spawn in roadside ponds adjacent to any type of coniferous or deciduous woodland.

Natural History

Wood Frogs move out from their places of hibernation during early spring. The earliest record is March 22, 1983, when one adult was found migrating across wet highway at Forties Settlement area, Lunenburg County.

Wood Frogs are the earliest of the frogs to spawn. The males, which usually far outnumber the females, congregate on the surface in vegetated areas of ponds and begin to call a mate. The male's voice is a hoarse "r-r-racket—r-r-racket—r-r-racket", and has been likened to a number of ducks quacking in a distant pond. The males are vocal throughout the night, as long as temperatures are above freezing, but may also be vocal during the day (Figure 91).

The breeding season extends from late March to early April in Yarmouth and Shelburne Counties and from early to late May in northern Cape Breton Island. It was the height of the breeding

Figure 91.

A male Wood Frog vocalizing on the surface of a roadside pond near Caledonia, Queens County at 1220 hrs on April 29, 1975

Figure 93.

A pair of Wood Frogs spawning in a roadside cattail pond at West Bay Road, Kingsville, Inverness County, at 2234 hrs on May 13, 1975

season at West Bay Road, Kingsville, Inverness County on the overcast night of May 13, 1975. Between 2100 and 2300 hrs, while male Yellow-spotted Salamanders were courting females on the bottom and Northern Spring Peepers called from the margin of the pond, more than 20 male Wood Frogs were vocal and moving about the surface of the pond. The vocal sacs of some of the males were so inflated they had great difficulty diving under the vegetation. Three pairs of Wood Frogs were observed in amplexus (Figure 92) and at 2234 hrs one pair was observed spawning on a dead cattail stem (Figure 93). Two Wood Frog egg masses, which were also fixed to cattail stems, apparently had been laid several nights earlier.

Based on the egg counts from 23 preserved females, Wood Frogs produce from 635 to 1,279 eggs each year (Figure 94). However, 10 freshly laid egg masses gathered from ponds had egg counts ranging from 552 to 1,267. The mean number of eggs from the preserved females is 904.7, while the mean for the 10 freshly laid egg masses is 860.8. On May

Figure 92.

A pair of Wood Frogs in amplexus in a roadside cattail pond, Port Hastings, Inverness County, at 2120 hrs on May 13, 1975

2, 1978, between 1930 and 2030 hrs, while a loud congregation of Wood Frogs was heard in a small section of cattails, in an extensive pond near the railroad at Tatamagouche, Colchester County, 53 egg masses were counted. As many as eight masses of eggs were fixed to a single cattail stem. The tops of some of the egg masses were exposed to the air (Figure 95). The tadpoles develop rapidly and transform during July and August.

Wood Frogs begin feeding after the spawning season. They prey upon a variety of insects and other small invertebrates, particularly spiders, beetles, bugs, moth larvae, slugs and snails. From the stomachs of 54 Wood Frogs the following prey have been identified:

sowbugs (Isopoda)
centipedes (Chilopoda)
pseudoscorpions (Chelonethida)
harvestmen (Phalangida)
soil mites (Acarina)
spiders (Araneida)
springtails (Collembola)
cricket (Gryllidae)
leafhoppers (Cicadellidae)
ground beetles (Carabidae)
click beetles (Elateridae)
scarab beetles (Scarabaeidae)
leaf beetles (Chrysomelidae)
snout beetles (Curculionidae)
caddisflies (Trichoptera)
mourningcloak butterfly larvae (*Nymphalis antiopa*)
noctuid moth larvae (Noctuidae)
crane flies (Tipulidae)
mosquitoes (Culicidae)
pomace flies (Drosophilidae)
ants (Formicidae)
earthworms (Oligochaeta)
slugs (*Deroceras reticulatum*)
snails (*Zoogenites harpa*, *Succinea* sp., *Zonitoides* sp., *Hygromia hispida*)

Wood Frogs retire to their places of hibernation during the autumn. The latest date recorded was November 5, 1982, when three adults were collected on wet highway in the Forties Settlement area, Lunenburg County.

Figure 94.

Number of ovarian eggs in relation to body length in 23 female Wood Frogs from Nova Scotia

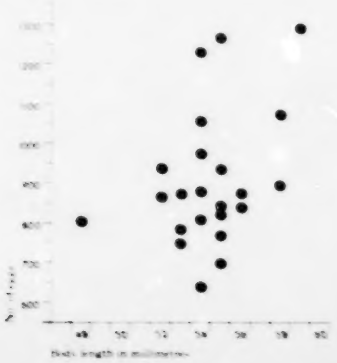


Figure 95.

Part of a Wood Frog spawning site among cattails in a pond near the railroad at Tatamagouche, Colchester County, on May 2, 1978

Northern Leopard Frog

Rana pipiens Schreber

Variation

COLOUR

Northern Leopard Frogs are usually grass-green, or occasionally brown, with black spots on the back and sides. The spots on the body and forelegs are oval while those on the hind legs are elongate or irregular blotches. When one of these frogs is in the normal resting position, some of the elongate spots on the tibia and tarsus are in line and form from one to four bands across the back of each folded leg. There are usually two spots on the back of the head, one over each eye, but many individuals also have a third spot, which is between and in front of the eye spots. The total number of spots on the back, including the spots on the head and those between the dorsolateral folds, ranges from eight to 23, but nine to 17 spots are more common. Some individuals have variable numbers of additional smaller black spots. The lower sides are greyish-white washed with green on green individuals and greyish-white washed with brown on brown individuals. The underside is white. The colour of small juveniles has a metallic lustre.

LENGTH OF NEWLY TRANSFORMED YOUNG

The body length of 13 newly transformed young ranged from 24 to 26 mm (Table 17). The tibia represents from 45.8 to 52 per cent of the body length of these young.

LENGTH OF ADULTS

The body length of 74 adult males ranged from 57 to 78 mm while that of 44 females ranged from 66 to 95.3 mm (Figure 96). The tibia represented from 50 to 63.2 per cent of the body length in 36 of these males and from 50 to 58.1 per cent in 24 of the females (Table 17).

DORSOLATERAL FOLDS

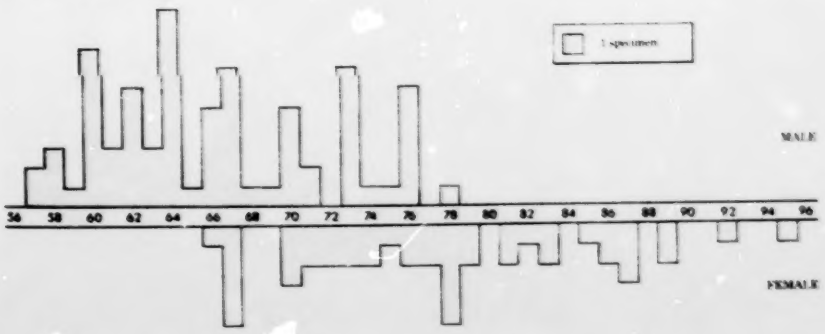
The dorsolateral folds are prominent and extend the length of the trunk. There are usually two, occasionally four, smaller dorsal folds between the dorsolateral folds.

Distribution

In Canada the Northern Leopard Frog ranges from the Maritime Provinces throughout most of Quebec and Ontario and across the Prairie Provinces to the Rocky Mountains. It also occurs in the southern valleys of the central and eastern regions of British Columbia. Its range extends as far north

Figure 96.

Body length measurements in millimetres of 118 adult Northern Leopard Frogs from Nova Scotia (74 males and 44 females)



as Fort Smith in the Northwest Territories. In the United States its range extends south to Pennsylvania and Kentucky in the east and to Nevada, Arizona and New Mexico in the west. In Nova Scotia the Northern Leopard Frog is widespread throughout the mainland and Cape Breton Island (Figure 97).

Figure 97.

Distribution of the Northern Leopard Frog in Nova Scotia

Table 17:
Length measurements in millimetres of 131 Northern Leopard Frogs from Nova Scotia

No. of Individuals, Sex, Recorder, Years collected	Body Length Range (Mean)	Tibia/Body Ratio Range (Mean)
13 newly transformed young J. Gilhen, 1969	24.0-26.0 (24.6)	.458-.520 (.486)
38 adult males J. S. Bleakney, 1950	57.2-76.2 (67.3)	
36 adult males J. Gilhen, 1969-1980	57.0-78.0 (65)	.500-.632 (.562)
20 adult females J. S. Bleakney, 1950	66.7-95.3 (79.2)	
24 adult females J. Gilhen, 1969-1980	66.0-92.0 (76.1)	.500-.581 (.540)

Habitat

The Northern Leopard Frog is commonly called meadow frog or grass frog because it spends a great deal of time foraging in grassy places during the summer. It is frequently seen in old fields, meadows, grassy-sedge woods roads (Figure 98) and grassy roadside ditches. Juveniles are often seen resting on sphagnum at the margins of roadside ponds.

Natural History

Northern Leopard Frogs surface from the bottom of their aquatic places of hibernation during spring. The earliest record is on the night of March 27, 1973 when an adult male was found on wet highway at Danesville, Queens County.

From mid-April to mid-May the males rest, with limbs spread out, on the surface in the shallows of ponds and vegetated coves of lakes, and begin calling a mate. Their voice has been described as a long-drawn-out rattling snore followed by several rapid grunts. Soon after the females have located males (Figure 99) they spawn. The eggs are usually laid in a loose oval mass in the shallows. Based on the eggs counted in 13 preserved females, Northern

Figure 98.

Grassy-sedge woods road leading to McCabe Lake, Halifax County, where Northern Leopard Frogs and Pickerel Frogs are commonly seen

Leopard Frogs produce from 2,167 to 3,767 eggs each year (Figure 100). A total of 10 freshly laid egg masses was observed in a deep silty-bottomed cattail marsh at Black Point, Cape Breton Island on the evening of May 10, 1978. The smallest mass contained 2,247 eggs and the largest mass contained 3,764 eggs. The newly hatched tadpoles remain in a close group (Figure 101) for some time before dispersing. The tadpoles develop rapidly and transform during July and August.

Northern Leopard Frogs feed on a variety of insects and other invertebrates. Terrestrial insects, many of which are agricultural pests, make up most of their diet, but aquatic insects are also eaten, particularly by juveniles. From the stomachs of 90 Northern Leopard Frogs the following prey have been identified:

sowbugs (Isopoda)
pseudoscorpions (Chelonethida)
harvestmen (Phalangida)
soil mites (Acarina)
spiders (Araneida)
mayfly nymphs (Ephemeroptera)
damselflies (Odonata)
short-horned grasshoppers (Acrididae)
crickets (Gryllidae)
water striders (Gerridae)
leaf bugs (Miridae)
stink bugs (Pentatomidae)
spittlebugs (Cercopidae)
leafhoppers (Cicadellidae)
ground beetles (Carabidae)
predacious diving beetles (Dytiscidae)
carrion beetles (Silphidae)
rove beetles (Staphylinidae)
soldier beetles (Cantharidae)
fireflies (Lampyridae)
pill beetles (Byrrhidae)
scarab beetles (Scarabaeidae)

Figure 99.

A pair of Northern Leopard Frogs in amplexus in the shallows of a grassy roadside pond near Sheridan Brook, Lunenburg County, at 2120 hrs on April 27, 1978

Figure 100.

Number of ovarian eggs in relation to body length in 13 Northern Leopard Frogs from Nova Scotia

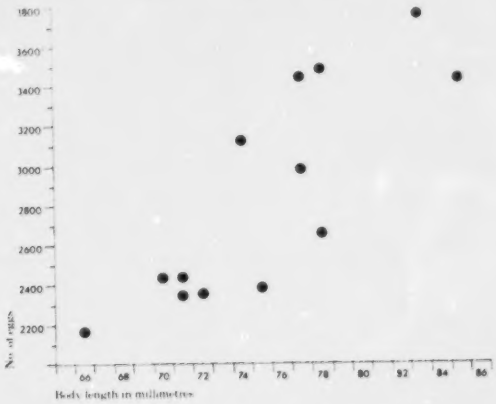


Figure 101.

Newly hatched Northern Leopard Frog tadpoles crowded around a branch and remnants of their egg mass in the shallows of a pond in a gravel pit near a tributary of Acacia Brook, Digby County, May 9, 1979

leaf beetles (Chrysomelidae)
snout beetles (Curculionidae)
caddisflies (Trichoptera)
tiger moth larvae (Arctiidae)
noctuid moth larvae (Noctuidae)
casebearer moth larvae (Coleophoridae)
crane flies (Tipulidae)
common sawfly larvae (Tenthredinidae)
ichneumon wasps (Ichneumonidae)
ants (Formicidae)
vespid wasps or paper wasps (Vespidae)
bumble bees (Apinae)

Northern Leopard Frogs return to aquatic habitats during the autumn to hibernate. The latest date was November 5, 1982, when a freshly-killed adult was collected on the road in the Forties Settlement area, Lunenburg County.

Pickerel Frog

Rana palustris Le Conte

Variation

COLOUR

Pickerel Frogs are yellowish-brown above with irregular square or rectangular brownish-black spots in rows down the back and along the sides of the body. There are small spots on the forelegs. There are usually three to five elongate spots or blotches on the tarsus and tibia of each hind leg. When one of these frogs is in the normal resting position, most of the tarsal spots either alternate with or do not perfectly line up with those on the tibia. When these spots do line up, they form bands across the back of the folded legs. There are usually two spots on the head, one over each eye and often a third one between and in front of the spots over the eyes. On rare occasions an individual lacks spots on the head or may have as many as five spots. The total number of spots on the back, including those on the head and the ones between the dorsolateral folds, ranges from seven to 21, but there are usually between nine and 15. Occasionally an individual is found with variable numbers of additional small brownish-black spots on the back and sides. The underside, from the chin past the mid-section, is greyish-white while the groin, remainder of the abdomen and the undersides of the hind legs are orange. The ground colour of juveniles has a metallic lustre and the orange underside is acquired with age.

LENGTH OF NEWLY TRANSFORMED YOUNG

The body length of 37 newly transformed young ranged from 24.5 to 29 mm (Table 18). The tibia represented from 46.2 to 56.9 per cent of the body length of these specimens.

LENGTH OF ADULTS

The body length of 41 males ranged from 49 to 63.5 mm while that of 38 females ranged from 50.8 to 74.6 mm (Figure 102). The tibia represented from 52.8 to 60.4 per cent of the body length in 22 of these males and from 54.4 to 61.4 per cent in 18 of these females (Table 18).

DORSOLATERAL FOLDS

The dorsolateral folds are prominent and extend the length of the trunk.

Table 18:
Length measurements in millimetres of 116 Pickerel Frogs from Nova Scotia

No. of Individuals, Sex, Recorder, Years collected	Body Length Range (Mean)	Tibia/Body Ratio Range (Mean)
37 newly transformed young J. Gilhen, 1970-1975	24.5-29.0 (26.7)	.462-.569 (.522)
19 adult males J. S. Bleakney, 1950	50.8-63.5 (56.3)	
22 adult males J. Gilhen, 1968-1979	49.0-58.0 (52.1)	.528-.604 (.573)
20 adult females J. S. Bleakney, 1950	50.8-74.6 (61.8)	
18 adult females J. Gilhen, 1972-1980	54.0-69.0 (61.7)	.544-.614 (.575)

Distribution

In Canada Pickerel Frogs occur in Nova Scotia, New Brunswick, southern Quebec and southern Ontario. In the United States their range extends south to the Carolinas and as far west as Wisconsin and eastern Texas. In Nova Scotia they are found in all regions of the mainland and Cape Breton Island (Figure 103).

Habitat

Pickerel Frogs are found along streams and shores of lakes, particularly near the inflow or outflow of streams. Their aquatic environment may be cool, rocky and sparsely vegetated or warm, silty-bottomed and densely vegetated. They also forage along grassy-sedge woods roads (Figure 104), roadsides, meadows and old fields. They are often found in association with Mink Frogs in vegetated aquatic habitats and with Northern Leopard Frogs in terrestrial habitats.

Figure 102.

Body length measurements in millimetres of 79 adult Pickerel Frogs from Nova Scotia (41 males and 38 females)

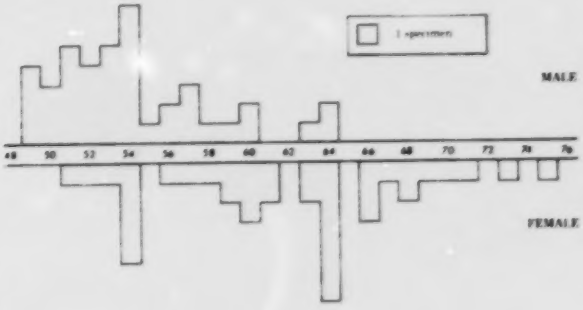


Figure 103.

Distribution of the Pickerel Frog in Nova Scotia

Natural History

Pickerel Frogs emerge from hibernation under the bottom debris and silt of their aquatic habitat during the spring. The earliest record is April 5, 1975, between 0045 and 0115 hrs, when an adult female was found on wet highway during a light rain at Princedale, Annapolis County, along with five Yellow-spotted Salamanders, six Northern Spring Peepers and two Wood Frogs.

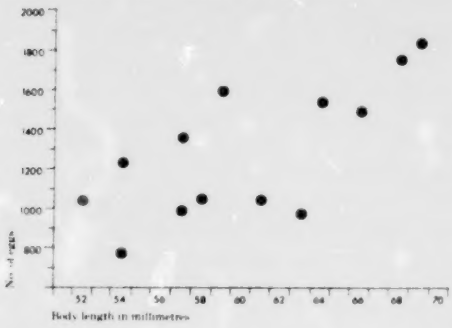
The breeding season is throughout May. On the mild and humid night of May 9, 1979, from 2235 to 2255 hrs, despite the repeated calling of a Barred Owl and a loud chorus of Northern Spring Peepers, the short low-pitched snore of five male Pickerel Frogs, which does not carry far, was heard at the inflow of a stream at Mallette Lake, Digby County. Soon after the female has located a male it spawns. The eggs are laid in a globular mass and the only two I have seen were at Minard Brook, Queens County. They were fixed to vegetation about 10 cm below the surface at the mouth of a backwater so that the eggs were gently swept by the current. Based on the number of eggs counted in 13 preserved females, Pickerel Frogs produce from 780 to 1,834 eggs each year (Figure 105). The tadpoles develop rapidly and transform during August and early September.

Pickerel Frogs feed on a great variety of insects and other small invertebrates. Of 37 newly transformed individuals found at McCabe Lake, Halifax County, 32 had eaten ants, along with a variety of other food items. Spiders, bugs, beetles, sawfly larvae, moth larvae and ants make up the bulk of their food, and they take in bits of vegetation, sand or gravel incidentally with this food. From the stomachs of 150 individuals the following prey have been identified:

sowbugs (Isopoda)
centipedes (Chilopoda)
pseudoscorpions (Chelonethida)
harvestmen (Phalangida)
soil mites (Acarina)
spiders (Araneida)
springtails (Collembola)

Figure 105.

Number of ovarian eggs in relation to body length in 13 Pickerel Frogs from Nova Scotia



damselflies (Odonata)
short-horned grasshoppers (Acrididae)
crickets (Gryllidae)
water boatmen (Corixidae)
leaf bugs (Miridae)
lace bugs (Tingidae)
stink bugs (Pentatomidae)
spittlebugs (Cercopidae)
leafhoppers (Cicadellidae)
ground beetles (Carabidae)
predacious diving beetles (Dytiscidae)
rove beetles (Staphylinidae)
fireflies (Lampyridae)
click beetles (Elateridae)
sap beetles (Nitidulidae)
scavenger beetles (Lathridiidae)

Figure 104.

Pickerel Frog foraging along a grassy-sedge woods road through coniferous forest near McCabe Lake, at 1015 hrs on July 25, 1980

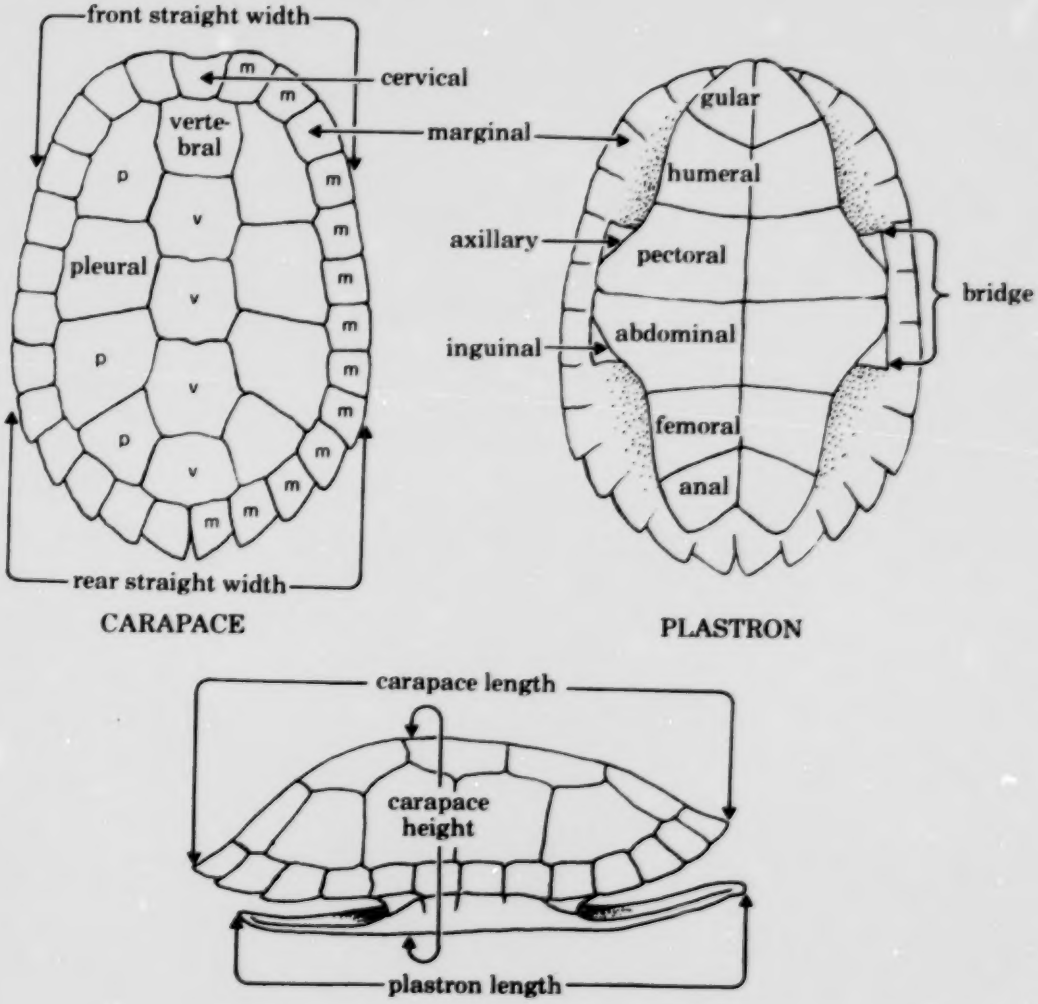
ladybird beetles (Coccinellidae)
scarab beetles (Scarabaeidae)
leaf beetles (Chrysomelidae)
snout beetles (Curculionidae)
common scorpionflies (Panorpidae)
caddisflies (Trichoptera)
geometer moth larvae (Geometridae)
tiger moth larvae (Arctiidae)
noctuid moth larvae (Noctuidae)
pyralid moth larvae (Pyralidae)
crane flies (Tipulidae)
midge pupae (Chironomidae)
syrphid flies (Syrphidae)
picture-winged flies (Otitidae)
shore flies (Ephydridae)
muscid flies (Muscidae)
tachinid flies (Tachinidae)
common sawfly larvae (Tenthredinidae)
encyrtid wasps (Encyrtidae)
braconid wasps (Braconidae)
ichneumon wasps (Ichneumonidae)
chalcidid wasps (Chalcididae)
ants (Formicidae)
snails (*Retinella* sp.)
slugs (Stylommatophora)
earthworms (Oligochaeta)

The stomachs of some individuals from the southwestern mainland were parasitized by nematodes.

Pickerel Frogs retire to their aquatic hibernation sites during the autumn. The latest record is October 30, 1935, when one was collected at East Roman Valley, Guysborough County.

Figure 106.

External characteristics and methods of measuring turtles



Turtles

Order: Testudines

There are 11 families of turtles known in the world today, comprising 72 genera and 222 species. Two families, the Snapping Turtles (Chelydridae) and the Box and Water Turtles (Emydidae) are represented in the Maritime Provinces. Also, two families of tropical marine turtles (Cheloniidae and Dermochelyidae) are represented in the Canadian Atlantic during the summer.

Turtles are easily distinguished from other reptiles by their protective shell. The top part of the shell is called the carapace and the bottom part is called the plastron (Figure 106). Turtles lack teeth but have a sharp-edged beak for biting.

Some people commonly call turtles that live in fresh water terrapins and those that live entirely on land tortoises. Collectively, however, they are properly called turtles.

The turtles native to the Maritime Provinces are easily identified from a distance by their colour pattern. However, farther south in the United States the ranges of many similar species overlap, and identification from a distance is often impossible.

Herpetologists measure the length and width of the carapace and plastron, as well as the height of the shell (Figure 106). They also note the number and arrangement of the plates or scutes on the carapace, and note whether or not the plastron is hinged.

Adult turtles have few enemies and predation is usually on eggs at nesting sites (Figure 107), or on the hatchlings. The Common Crow, Raccoon and Black Bear are known predators on turtle nests in Nova Scotia. Wood Turtles in particular are often found with part of a limb severed, probably by a Raccoon or other mammal. Some turtles are killed by automobiles while crossing roads en route to nesting sites.

Figure 107.

Eggs dug out of an Eastern Painted Turtle nest by a common crow near Harper Lake, Shelburne County, June 7, 1979

Snapping Turtles

Family Chelydridae

This family is comprised of two genera and two species. These are large, powerful, freshwater turtles. They have a big head with strong jaws and are particularly known for their attempts to bite when defending themselves.

The Snapping Turtle, *Chelydra serpentina*, represents the family in the Maritime Provinces. This species is a complex of two subspecies: the Common Snapping Turtle, *C. s. serpentina*, widespread throughout most of the species' range in eastern North America; and the Florida Snapping Turtle, *C. s. osceola*, native to peninsular Florida and southern Georgia.

Common Snapping Turtle

Chelydra serpentina serpentina (Linnaeus)

The Common Snapping Turtle has a large head with two small barbels on the chin and tubercles on its long thick neck. There are three keels on the carapace and the posterior marginals are strongly pointed. This species has a small cruciform plastron. Its limbs and tail are muscular. There is a central row of raised crestlike bony plates along the top of the long tail and paired plates on the underside, two characteristics found on some fossil reptiles. These characteristics, along with the colour and large adult size, distinguish the Common Snapping Turtle from the other turtles native to Nova Scotia.

Variation

COLOUR

The carapace of Common Snapping Turtles varies from tan to dark brown with blackish-brown streaks radiating from the apex of each shield. Many individuals appear to vary from greenish-grey to dark green because of algae growing on the carapace. The growth is so dense on some individuals that it trails over the sides of the marginals. The raised plates on top of the tail are of the same ground colour as the carapace. The top and sides of the head, as well as the top of the tail and outer sides of the limbs, are brown or grey. The undersides are dull yellow or olive-grey. The top of the head is speckled with black and there is heavy black blotching behind the eyes. The jaws are vertically streaked with black. The plastron colour varies. Most specimens have a light yellow or olive-grey plastron with varying amounts of black in the centre.

LENGTH OF ADULTS

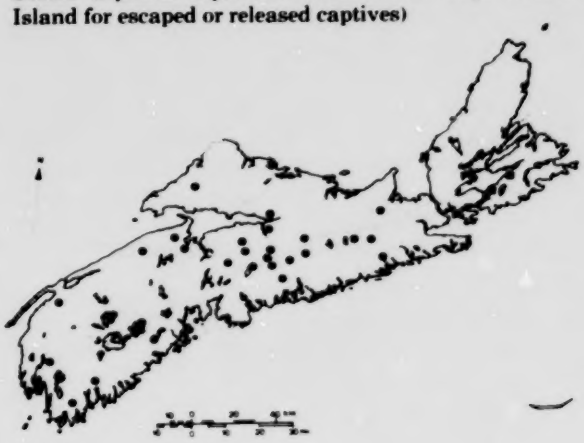
Mature Common Snapping Turtles usually range from 22 to 35 cm in length. Larger individuals are uncommon. Males often attain a larger size than females. For example, in Kejimkujik National Park, the carapace length of eight nesting females captured at Grafton Lake ranged from 22.9 to 26.7 cm, while a mature male captured at West River had a carapace length of 33 cm.

Distribution

In Canada the Common Snapping Turtle ranges from mainland Nova Scotia and New Brunswick to southern Saskatchewan. It is widely distributed throughout most of the eastern and central United States, as far south as the Gulf of Mexico and as far west as the Rocky Mountains. In Nova Scotia it is common in the southwestern mainland and is less common northeast of Halifax County (Figure 108). There are three records for Cape Breton Island. A large adult was observed in August 1953 on the beach at Port Hood, Inverness County; one adult female, 30 cm long, was collected May 18, 1977 by the roadside at Campbell's Brook, Richmond County; and an adult male 34.5 cm long was collected on the same day at Breac Brook, Cape Breton County. These individuals are believed to have been released captives.

Figure 108.

Distribution of the Common Snapping Turtle in Nova Scotia (squares represent localities in Cape Breton Island for escaped or released captives)



Habitat

The Common Snapping Turtle frequents the vegetated shallows of lakes and streams, though it may be found in practically any type of freshwater habitat. Early in the morning or in the evening, when surface water is calm, it rises from the bottom and can be seen with its head extended above the surface as though studying the surrounding landscape. This species is rarely seen out of water basking on exposed rocks or logs as other Nova Scotian turtles do.

Natural History

Common Snapping Turtles surface from their aquatic places of hibernation during May.

Before daylight or late in the afternoon during the last two weeks of June and the first week of July, mature females leave the water for a brief period to locate and dig a nest to lay their eggs. The nest may be in sand or gravel on a beach a few metres above the water mark or in soil on a woods road 100 metres or more from the nearest body of water. Gravel roadbanks, tilled soil in gardens and sawdust piles at millsites are also used as nesting sites. Based on the number of eggs counted in eight females from Grafton Lake, Queens County, Common Snapping Turtles in Nova Scotia produce from 19 to 41 eggs each year. The eggs are spherical and range from 28.5 to 35.5 mm in diameter. Once the eggs have been covered the females return to the water.

The eggs hatch between late September and the end of October. Bleakney (1963) reported on the overwintering of hatchlings in the nest. He suggested that they will not dig upwards when the ground above the nest is colder than within the nest. Consequently they are trapped until the following spring. Hatchlings which emerge from nests on the shore move directly to the shallows, while those that emerge from more distant nests may stay for a while in the first body of water they come to.

Common Snapping Turtles are known to eat aquatic invertebrates, fish, amphibians and to a lesser extent reptiles, birds and small mammals. Prey is devoured under the surface. They have a

Figure 109.

Proper method of handling a Common Snapping Turtle

keen sense of smell and will travel a considerable distance to traps baited with fish or meat. Of the three mature specimens from Nova Scotia examined for stomach contents, one contained a common white sucker, *Catostomus commersoni*, one had eaten a golden shiner, *Notemigonus crysoleucas*, and the third had eaten at least part of a young bird.

The Common Snapping Turtle has an unwarranted reputation for being a threat to people swimming. The fact is that these turtles are rather shy of humans and prefer to move away when approached. To deliberately remove one from its aquatic habitat or to disturb a nesting female is a foolish act. Because of their large size and their sharp jaws and gaping mouth, they can inflict a painful wound. If molested, an individual will vigorously threaten by lifting its posterior, lunging forward and attempting to bite. This turtle can reach back to about halfway along its carapace, so if one must be handled it should be approached from behind and picked up by the base of the tail, with plastron facing you but held out from your leg (Figure 109).

Common Snapping Turtles retire to their underwater hibernation sites during the autumn.

Semiaquatic, Pond and Marsh Turtles

Family Emydidae

This is the largest family of turtles and comprises 31 genera and 85 species. Members of this family are found in northern Africa, Asia, Europe, and North, Central and South America. They have a well-developed carapace and plastron with a wide bridge joining them. The family is represented in Nova Scotia by the Wood Turtle, Blanding's Turtle and Eastern Painted Turtle.

Spotted, Wood, Western Pond and Bog Turtles

Genus *Clemmys*

Of the four species included in this North American genus, the Wood Turtle is the only one native to Nova Scotia and New Brunswick.

Wood Turtle

Clemmys insculpta (Le Conte)

The Wood Turtle is easily distinguished from the other turtles native to Nova Scotia by the shape of its carapace and colour. The raised pyramid-like shields, prominent central keel and slight upward flare of the pointed posterior marginals give this turtle its unique shape. It is this sculptured appearance that earned the Wood Turtle its specific name *insculpta*. The plastron of mature males is prominently concave while that of females is slightly convex. Wood Turtles are heavily clad with protective scutes on the legs, particularly in the males. The sides of the head are arched downward and this trapezoid shape, along with the dark weeping eyes, gives the Wood Turtle a sad look.

Variation

COLOUR

The carapace of Wood Turtles is brown with black and yellow streaks radiating from the apex of each

costal and central shield and also from the posterior extremity of each marginal shield. The plastron and the undersides of the carapace are yellow, with an irregular black blotch on the outside posterior corner of each scute. The head, top of the neck and tail, the outer scales of the legs and the claws are black. The undersides of the neck and legs are orange. It is the orange colour of the legs which earned Wood Turtles the name "redleg" at the market place in the United States, where they were sold for human consumption.

LENGTH OF ADULTS

A total of 23 Wood Turtles, nine males and 14 females, were captured, measured, marked and released in the St. Mary's River watershed, Guysborough County. The carapace range for the nine males was 19.5 to 21.6 cm in length while for the 14 females it ranged from 16.9 to 19.8 cm (Figure 110).

Figure 111.

Distribution of the Wood Turtle in Nova Scotia

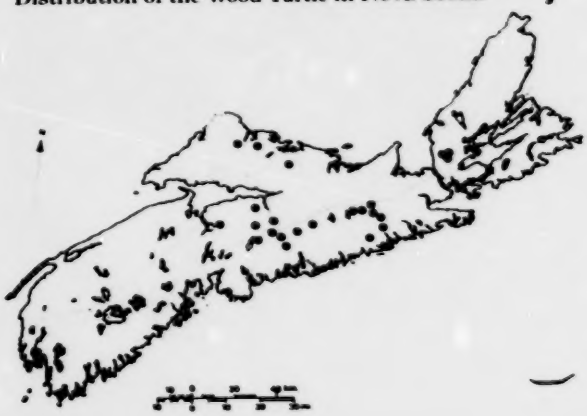
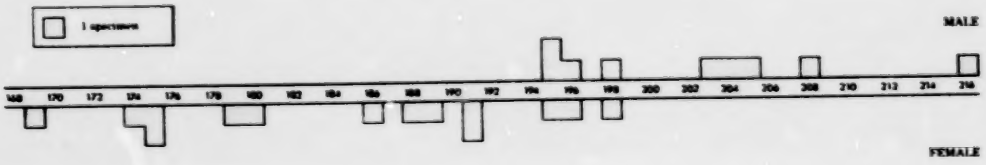


Figure 110.

Carapace length measurements in millimetres of 23 adult Wood Turtles from the St. Mary's River watershed, Guysborough County (9 males and 14 females)



Distribution

In Canada, Wood Turtles are found in Nova Scotia, New Brunswick, southern Quebec and southern Ontario. In the United States their distribution extends south to the Virginias and west to eastern Minnesota. In Nova Scotia, Wood Turtles are found in the northeastern mainland and southwestern Cape Breton Island (Figure 111). Wood Turtles are commonly removed from their habitat by persons who keep them as pets. Many of these turtles escape or are released far from their natural habitat.

Habitat

Wood Turtles inhabit slow-moving, meandering intervale streams which have some sand or gravel banks for nesting and which often flow through prime agricultural land. They are often seen during the day in woodlands, hayfields and along roadsides adjacent to streams.

Natural History

Wood Turtles surface from their aquatic hibernation sites during the spring. In late April and early May they begin their terrestrial activity by moving up on the river bank to bask in the sun for a few hours in the afternoon. It is this habit of basking on the muddy river bank which has earned this species the popular name "mud turtle".

During the last two weeks of June and the first week of July mature females move to sand or gravel banks. Here they excavate a nest above water and lay their eggs. Each female produces from 4 to 12 (commonly 8 to 10) ellipsoidal eggs. Hatchlings emerge from the nest in the autumn, probably in October.

nate. With head and limbs tucked in under the carapace but with tail extended, they lie next to submerged anchored stumps (Figure 113) and logs on the sides of the stream away from the main current.

During the summer Wood Turtles will travel upstream in the tributaries. They are omnivorous, feeding on horsetails, berries (Figure 112), earthworms, slugs, snails, insects and insect larvae. By October they return to the main stream to hiber-

Figure 112.

Juvenile Wood Turtle feeding on strawberries at Hattie Road, Glenelg, Guysborough County, at 0430 hrs on June 28, 1978

Figure 113.

One of two adult female Wood Turtles hibernating at a depth of 1.5 metres on the sandy bottom on the north side of East River St. Mary's, Guysborough County, at 1330 hrs on November 7, 1979. Their carapaces were covered with a thin layer of silt as they lay next to a submerged anchored stump and log. (Photograph courtesy of Gordon Murray and John Carter of Martec Limited)

Blanding's Turtle

Genus *Emydoidea*

The Blanding's Turtle (*Emydoidea*) and the Chicken Turtle (*Deirochelys*) are closely related. They differ from other members of the family Emydidae in having a long neck. The first vertebral scute is in contact with four marginals (instead of two) and the cervical. The Chicken Turtle is found in the southern United States and differs from the Blanding's Turtle in having a rigid plastron instead of a hinged one.

Blanding's Turtle

Emydoidea blandingi (Holbrook)

The Blanding's Turtle is easily distinguished from the other turtles native to Nova Scotia by its high domed carapace. It is often called "semi-box" turtle because its hinged plastron only closes completely at the rear.

Variation

COLOUR

The carapace of the Blanding's Turtle is greyish-black and profusely spotted or streaked with greyish-yellow. The plastron is yellow with black blotches of variable size on the outer posterior corner of each scute. The top of the head and neck are black and the undersides are bright yellow. The limbs and tail are black.

LENGTH OF ADULTS

Wayne Weller measured 17 Blanding's Turtles in Kejimkujik National Park. The carapace length of six males ranged from 18.4 to 22.3 cm while that of 11 females ranged from 18.9 to 22.4 cm (Figure 114).

Distribution

The range of the Blanding's Turtle extends from southern Ontario and adjacent Quebec west to

southeastern Minnesota and south to northwestern Pennsylvania, central Illinois and north-central Nebraska. There are a number of disjunct populations east of Illinois and one north of Nebraska. In Canada there is a disjunct relict population in Kejimkujik National Park in southwestern Nova Scotia (Figure 115). A few individuals believed to be escaped or released captives have been found outside the park.

Habitat

Blanding's Turtles in Nova Scotia inhabit the vegetated coves and bogs of northern Kejimkujik Lake and western Grafton Lake, as well as the vegetated inlets and boggy marshland near the drainage of West, Little and Mersey Rivers (Figure 116), where they are often seen basking on sphagnum and grass hummocks.

Figure 115.

Distribution of the Blanding's Turtle in Nova Scotia

Natural History

Blanding's Turtles surface from their aquatic hibernating sites during spring. Although elsewhere these turtles are also known to hibernate in leaf litter at the edge of aquatic habitats, terrestrial hibernation has not been observed in the Nova Scotian population.

Mature females move to sand or gravel beaches and to gravelly soil in open areas usually during late afternoon and evening from early June to early July in order to nest. The beach area south of Heber Meadow is considered to be the most productive nesting site (Figure 117).

Females produce from 10 to 12 eggs each year. The hatchlings emerge from the nest during September and October.

Figure 116.

Blanding's Turtle basking habitat, Mersey River above Jacques Landing, July 1977 (Courtesy R. Thexton, Parks Canada)

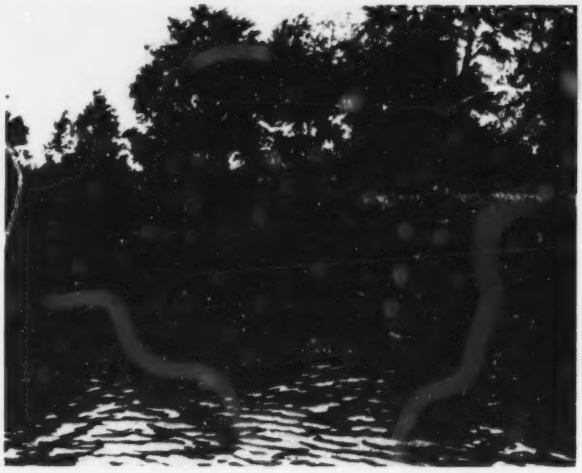
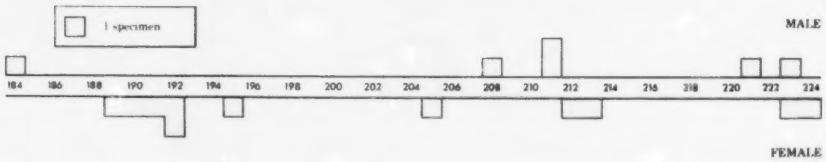


Figure 114.

Carapace length measurements in millimetres of 17 Blanding's Turtles from Kejimkujik National Park (6 males and 11 females)



Blanding's Turtles feed mostly on aquatic insects and snails, but carrion is also eaten. In the stomach, intestine and colon of eight individuals Bleakney (1976) found a total of 21 dragonflies, mostly nymphs (in five of these turtles); 20 snails (in four); 10 beetles (in five); 3 fish (in two); Nematodes (in four); 1 *Lethocenus* bug (in one); 1 mammal bone (in one); mammal hair (in one); vegetation (in six) and 1 fish hook (in one).

Blanding's Turtles retire to their aquatic places of hibernation during the autumn.

Figure 117.

Blanding's Turtle laying eggs in nest on the beach at Heber Meadow, Kejimkujik Lake at 2200 hrs on June 26, 1980 (Courtesy R. Thexton, Parks Canada)

Cooters, Sliders, Painted Turtles and Their Allies

Genus *Chrysemys*

This genus occupies most of eastern North America south of southern Canada but extends west to southern British Columbia and northern Oregon. The Painted Turtle (*Chrysemys picta*) is a complex of four subspecies: the Eastern Painted Turtle, *C. p. picta*; the Midland Painted Turtle, *C. p. marginata*; the Southern Painted Turtle, *C. p. dorsalis*; and the Western Painted Turtle, *C. p. belli*. Each subspecies is distinguished by its colour pattern and by the alignment or disalignment of the scutes of the carapace.

The Eastern Painted Turtles in Nova Scotia show characteristics of both the Midland and Eastern Painted Turtles. There is slight misalignment of the scutes of the carapace, unlike typical Eastern Painted Turtles, which have these scutes in diagonal rows. Also, many of the Eastern Painted Turtles in Nova Scotia have a plastral blotch, a characteristic of the Midland Painted Turtle. Typical Eastern Painted Turtles have a plain or unblotched plastron.

Eastern Painted Turtle

Chrysemys picta picta (Schneider)

Variation

COLOUR

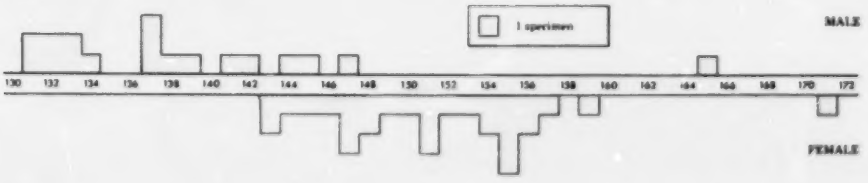
The Eastern Painted Turtle is the most colourful turtle native to Nova Scotia. The ground colour varies from dark greenish-black to black. The smooth black scutes of the carapace are separated by greenish-yellow margins. There is a thin greenish-yellow or brownish-yellow stripe down the middle of the carapace and the upper and lower surface of the marginals are marked with red. The plastron is yellow but many individuals have a dark plastral blotch which varies in size and is often streaked or spotted with red. There are four yellow spots on the upper sides of the head. The sides of the head, including the eyes, are streaked with yellow, changing abruptly to red on the neck. The legs, particularly the front legs, are marked with red. The upper sides of the tail have a yellow stripe while the lower sides have a red stripe.

LENGTH OF ADULTS

Wayne Weller measured 46 adults, 18 males and 28 females, from Kejimkujik National Park in southwestern Nova Scotia. The carapace length of the males ranged from 13.1 to 16.5 cm while that of the females ranged from 14.3 to 17.1 cm (Figure 118).

Figure 118.

Carapace length measurements in millimetres of 46 adult Eastern Painted Turtles from Nova Scotia (18 males and 28 females)



Distribution

In Canada the Eastern Painted Turtle is found in mainland Nova Scotia and New Brunswick. Its range extends south to Alabama in the United States. In Nova Scotia it is common to abundant in the southwestern mainland, becoming locally common or absent on the northeastern mainland (Figure 119).

Figure 119.

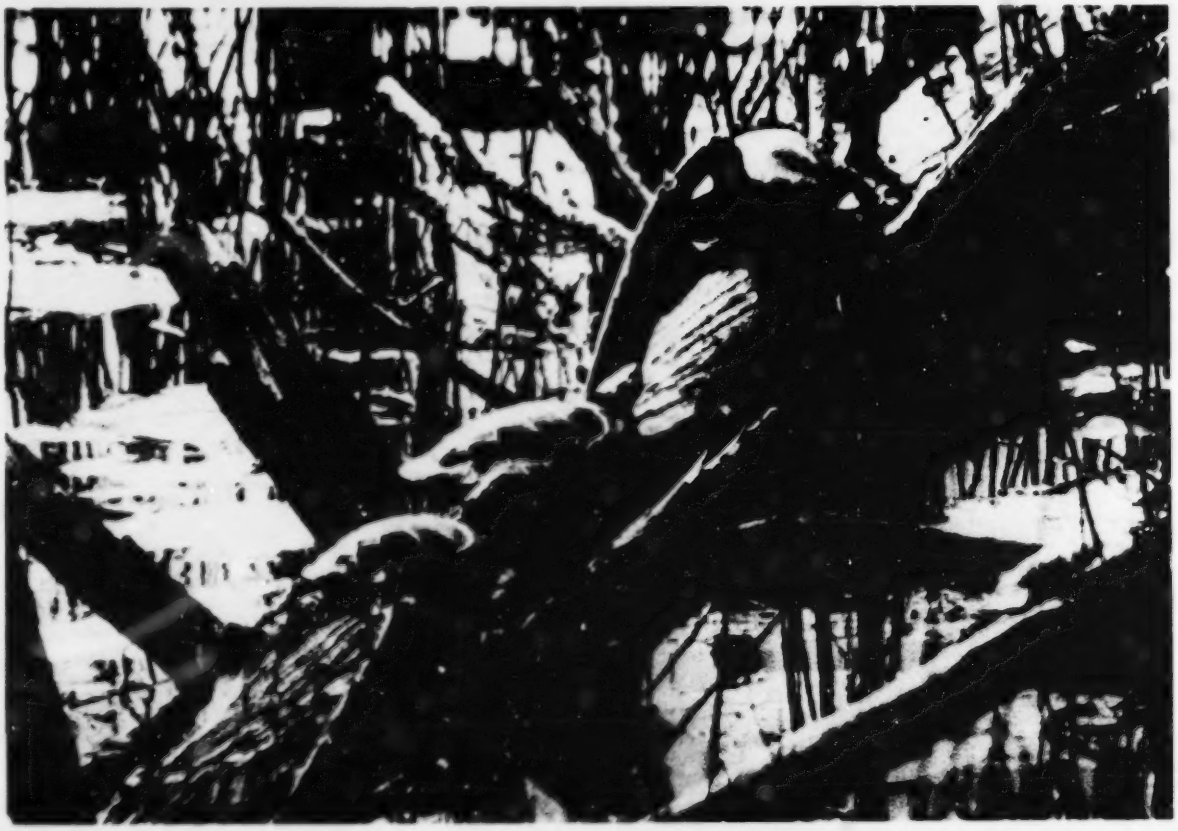
Distribution of the Eastern Painted Turtle in Nova Scotia

Habitat

Eastern Painted Turtles inhabit vegetated ponds, lakes and streams. They are often seen in numbers basking in the sun on logs (Figure 120), stumps and exposed rocks as well as on sphagnum along boggy shorelines. They seem to be most common where lily pads and pickerel weed grow in ponds, lakes, and streams.

Figure 120.

Eastern Painted Turtles basking on a log in the shallows of a lake in Dartmouth, Halifax County



Natural History

Eastern Painted Turtles surface from their aquatic hibernating sites during spring.

Mature females migrate to sand or gravel beaches and to a variety of other terrestrial situations, such as along roadbanks and cultivated fields, during the afternoon from early June to early July, to dig a nest and lay their eggs (Figures 121 and 122). Based on the counts of oviducal eggs of 23 Eastern Painted Turtles from Nova Scotia, C. Bruce Powell (1965) found that the females produce from 6 to 11 eggs each year.

The hatchlings emerge from the nest between late September and the end of October. However, if the nest surface temperature becomes lower than the temperature of the bottom of the nest, the hatchlings will overwinter in the nest and dig their way out the following spring.

Eastern Painted Turtles are considered to be diurnal. However, between 1300 and 1500 hrs on June 7, 1968, I observed 14 adults embedded like beach stones on the sandy bottom at a depth of less than one metre in the shallows of Long Lake, Lunenburg County. Only the tops of their carapaces were exposed and each one was difficult to lift from the bottom. Also, on two occasions the author observed nocturnal feeding. The first observation was at 2300 hrs about the first week of August 1963 at a brook which flows from Grafton Lake to Kejimkujik Lake, Queens County. The second time was at 2230 hrs, August 13, 1977 at Minard Brook, Queens County. Both specimens observed were adult females. They were moving slowly over the bottom with their heads arched downward, as if they were smelling the gravel, and they were biting at stonefly nymphs.

Eastern Painted Turtles feed on a variety of aquatic insects, their larvae or nymphs, and other invertebrates, particularly snails. They also ingest pieces of water lily pads along with their animal food.

Eastern Painted Turtles retire to their aquatic places of hibernation during the autumn.

Figure 121.

Trail of a female Eastern Painted Turtle up a grassy kame nesting site at Harper Lake, Shelburne County, at 1920 hrs on June 6, 1979

Figure 122.

Female Eastern Painted Turtle digging a nest on a grassy kame at Harper Lake, Shelburne County, at 1935 hrs on June 6, 1979

Marine Turtles

Families Cheloniidae and Dermochelyidae

Marine turtles are large reptiles and are easily distinguished from the terrestrial or freshwater turtles by their paddle-like flippers.

There are seven species of marine turtle and three of them, the Atlantic Loggerhead and the Atlantic Ridley (family Cheloniidae) and the Atlantic Leatherback (family Dermochelyidae), have been recorded in Nova Scotian waters from late spring to early autumn. Their presence here was once thought to be a rare or unusual occurrence. However, observations by scientists and closer contact with fishermen who have observed sea turtles a number of times over their years of fishing, indicate that these reptiles visit Nova Scotia every summer.

All marine turtles are considered to be endangered species. For many years their eggs have been dug out of nesting sites on sandy beaches in the southern United States, Mexico and the tropics, for human consumption. The adults are captured and also used for food, and their skins and shells are used commercially. Many countries are now protecting these oceanic turtles. We should recognize that they are an important part of our herpetofauna and should contribute to their conservation by releasing individuals which survive being tangled in fishing gear.

Atlantic Ridley

Lepidochelys kempi (Garman)

The Atlantic Ridley has a heart-shaped, keeled carapace. It is distinguished from the Atlantic Loggerhead especially by having four pairs of pore-bearing inframarginals on the bridge, and by its colour and adult size.

The carapace varies from pale yellowish-grey to grey. The bridge and plastron are white. The upper sides and top of the head and the flippers are grey.

The Atlantic Ridley is the smallest species of marine turtle found in our waters. Adults usually range from 58 to 70 cm in length and weigh from 36 to 45 kg. Larger individuals are uncommon.

There are four records of Atlantic Ridley in Nova Scotian waters. Two juveniles were collected in 1910. One measuring 24.8 cm was captured August 15 near the LaHave Islands, Lunenburg County, and one measuring 26.4 cm was collected August 23 at Spry Harbour, Halifax County. Two more juveniles were collected along the Bay of Fundy in 1928. One measuring 28.9 cm was found October 14 near Margaretsville, Annapolis County, and one measuring 25.4 cm was found October 18 somewhere in the Bay of Fundy (Piers 1910 and 1928, and Bleakney 1955).

Atlantic Loggerhead

Caretta caretta caretta (Linnaeus)

The Atlantic Loggerhead has an elongate, keeled carapace. It is distinguished from the Atlantic Ridley especially by having three pairs of poreless inframarginals on the bridge and by its colour and adult size.

The carapace is reddish-brown and the plates or scutes are often bordered with yellow. The bridge and plastron vary from yellow to yellowish-cream. The head varies from reddish-chestnut to olive-brown, and the scales also are often bordered with yellow. The flippers and tail are dark reddish-brown above and yellowish-brown below.

The Atlantic Loggerhead is a large marine turtle. Adults usually range from 79 to 114 cm in length and weigh 77 to 150 kg. Larger individuals are uncommon.

Only two Atlantic Loggerheads have been captured in inshore Nova Scotian waters. The first specimen was a juvenile about 30.5 cm long captured three miles off Devil's Island, Halifax County. This record is based on a painting done in 1931 by the late C. E. Johnston, of the National Museums of Canada. The second was an adult, 72.4 cm long, which was captured just off Chebucto Head, near Halifax, on June 14, 1964. A fibreglass mold was made of the entire turtle and a fibreglass model is now on display at the Nova Scotia Museum. Fishermen active on Georges Bank have seen these turtles a number of times over their years of fishing, and occasionally one is kept for a short time in the frozen fish display at the Lunenburg Fisheries Exhibition.

Atlantic Leatherback

Dermochelys coriacea coriacea (Linnaeus)

The Atlantic Leatherback is easily distinguished from the other oceanic turtles by its smooth leather-skinned carapace, which has seven prominent longitudinal keels, instead of distinct scutes, and by its colour and adult size.

The Atlantic Leatherback varies from brown to black on the carapace, head and neck. The flippers are black but may have some white blotches. The plastron is white with some black blotching.

The Atlantic Leatherbacks are the largest living turtles in the world. Adults usually range from 137 to 178 cm in length and weigh 295 to 544 kg. Larger individuals are uncommon. This species has its throat lined with backward-pointing spines, an adaptation that enables it to feed extensively on jellyfish.

The Atlantic Leatherback is by far the most common sea turtle recorded in Nova Scotian coastal waters. This may be due to the huge size and the fact that they frequently become tangled in fishing gear. Bleakney (1965) recorded 23 individuals up to 1965. Most of the records are from Halifax County, but they can be expected to occur anywhere along the coast of Nova Scotia.

Snakes

Order: Squamata
Sub-order: Serpentes

The snakes, the lizards (sub-order Lacertilia), and the amphisbaenians (sub-order Amphisbaenia) comprise the order Squamata. There are no lizards native to the Maritime Provinces and the amphisbaenians, which are elongate, cylindrical-shaped burrowers that look like earthworms, are not native to Canada.

There are 14 families of snakes with approximately 2,267 species. The family Colubridae, the typical snakes, is the only family represented in the Maritime Provinces.

The term "squamata" means covered with scales. With the exception of the eyes and nares, snakes are completely clad in scales. The vent is protected by a ventral scale. However, the scales are not interlocked and when prey is being swallowed or when the snake breathes deeply, the skin between the scales is exposed. Snakes are elongate animals which lack complete limbs and external ear openings. They have a forked tongue which can extend far beyond the mouth (Figure 123) to sample particles in the air and carry them back to a special smelling structure called Jacobson's organ, on the roof of the mouth. This is important in detecting prey.

Most people have been conditioned to dislike and fear snakes. The snake has been a symbol of distrust for centuries. For example, the devil is traditionally disguised as a snake in the Garden of Eden with Adam and Eve (Figure 124). Because some species inject a poisonous venom when they bite, most people treat all snakes with suspicion. Snakes are poorly-understood animals because most people accept as truth the numerous myths about them. Contrary to popular belief, snakes do not sting with their tongues, milk cows, put their tails in their mouths to form a hoop and roll away when frightened, or swallow their young to protect them and release them when danger has passed.

Herpetologists take three basic measurements of snakes: length of body, or snout to posterior angle of vent; length of tail, or posterior angle of vent to the tip of the tail; and total length (Figure 125). The total length can be divided into the tail length to obtain the tail/total ratio.

Snakes gradually become dull in colour with milky blue eyes as they are near the time to shed their skin. After shedding their skin they are bright and glossy. Herpetologists note the colour of snakes as soon as possible after capture. This is particularly important when specimens are being preserved for scientific study because there is drastic colour loss after death.

The type and number of scales are important characteristics. They are used in distinguishing between species and they often vary geographically within one species. Herpetologists first note

Figure 124.

End panel of a tombstone in Halifax, depicting the devil as a snake in the Garden of Eden with Adam and Eve

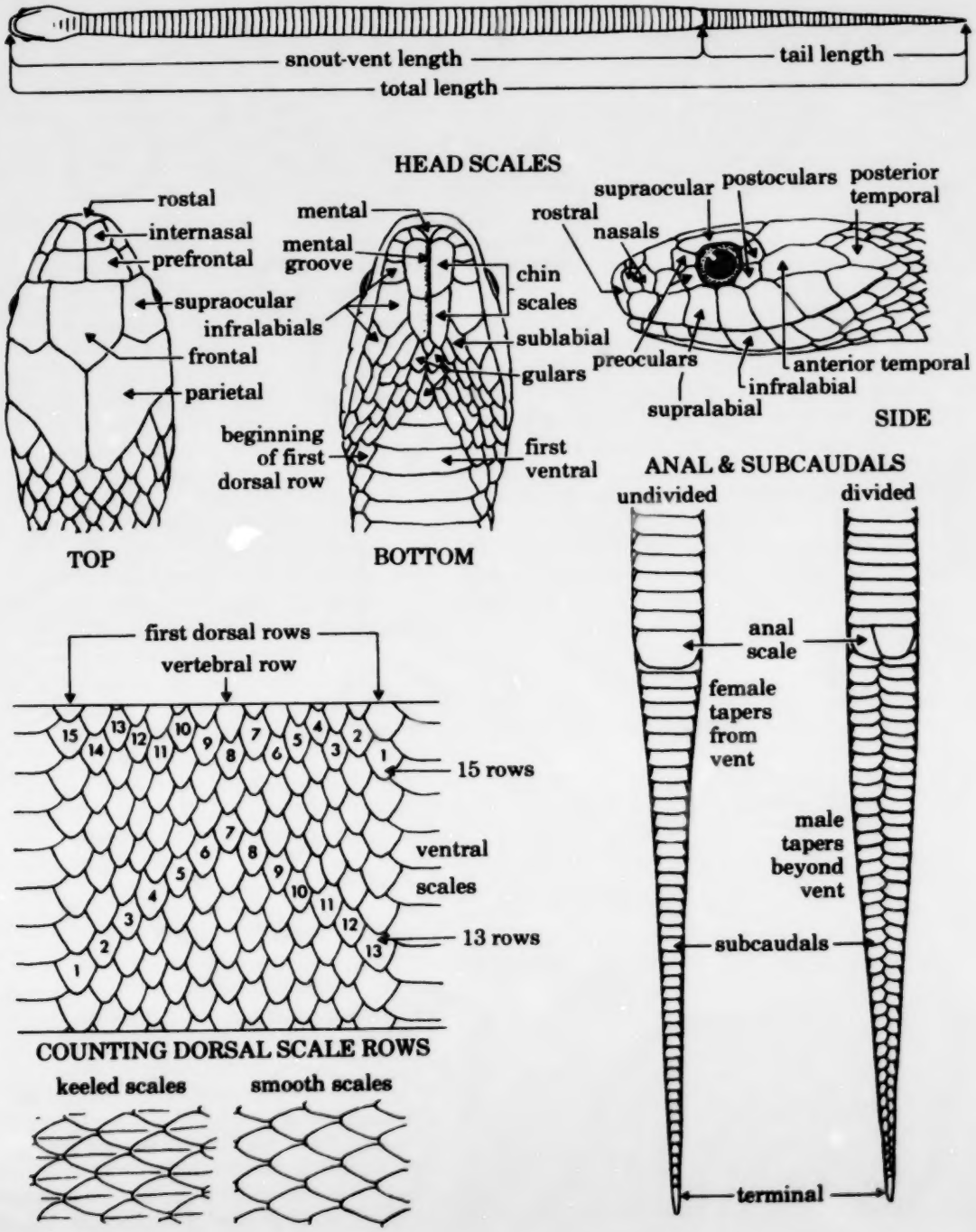
whether the scales on the back are smooth or keeled (Figure 125). The number of rows of these dorsal scales is counted on the neck, beginning just above the first abdominal or ventral scale (Figure 125), and the remainder of the trunk is looked at very closely to note where scale rows are dropped or gained, using the method proposed by Dowling (1951b) (Figure 125). The ventral scales are counted using a method also proposed by Dowling (1951a) (Figure 125). The scale covering the anus may be single or divided, depending on the species, and is not included in the ventral count. Herpetologists also note whether the scales on the underside of the tail, called sub-caudal scales, are single or paired (Figure 125). The single terminal scale on the tip of the tail is not included in the count. The scale or scales bordering the anterior side of the eye, called preocular scales, and

Figure 123.

Juvenile Maritime Garter Snake from Tomahawk Lake, Halifax County, with tongue extended to sample particles in the air

Figure 125.

External characteristics and methods of measuring snakes



those bordering the posterior side of the eye, called postocular scales, are counted for both eyes. The scales bordering the upper lip, called supralabials, and those bordering the lower lip, called infralabials, are counted on both sides of the mouth (Figure 125).

Typical Snakes

Family Colubridae

This is the largest family of snakes. There are 291 genera and 1,550 species, making up about 66 per cent of the snake species known in the world today. Most of the snakes in this family, including all the species native to the Maritime Provinces, are harmless. Many tropical species have enlarged fangs and are poisonous.

Most Maritime Garter Snakes will attempt to bite if a person tries to capture them. When there is no immediate escape route this snake will display an impressive defence, inflating its lungs with air and then flattening its body. The light skin between the scales on the back shows prominently, the depressed head, with repeatedly flicking tongue, faces the threat and with mouth open wide the snake will strike and regain its posture for another attack with amazing speed (Figure 126). The bite from one of these snakes, however, is more annoying than painful, and should be treated medically like any minor wound that punctures the skin.

Figure 126.

A juvenile female Maritime Garter Snake poised to defend itself on Hattie Road, Glenelg, Guysborough County, at 1740 hrs on June 27, 1978

In every community it seems there is at least one person who can recall an incredible story about snakes. Usually the story pertains to length. It is easy to overestimate the length of a snake when it is in motion. Probably this illusion of being longer than it actually is often contributes to a successful escape when a snake flees from predators.

Jones (1865), in his account of the "Black Snake", said "A coloured man some time ago informed me, that one of these snakes had chased him when a boy, the whole length of a field. I thought at the time that his account was much exaggerated, but I find from the best authorities that this habit of chasing an enemy is fully established, and that its force on such occasions is very great." A number of persons have told me that they recalled being chased by a large snake after they had suddenly approached one while on a hike or while picking berries. Snakes, like most animals, sometimes become very confused when they have been startled. I have observed a number of instances when a snake became confused and while trying to escape moved directly towards me. During a sunny afternoon, July 5, 1975, I observed a Maritime Garter Snake slowly moving along the margin of a small pond about 15 metres from the railway tracks at Louisdale, Richmond County. After I stepped on a loose railroad tie, causing a loud noise, the snake stopped momentarily and then swam quickly across the surface of the pond, moved up the railroad bank, crawled over the track and took shelter under the loose tie. Had this experience happened to someone unfamiliar with Maritime Garter Snakes, I am sure they would have believed that this snake was chasing them.

Snakes native to the Maritime Provinces either lay eggs (oviparity) or give birth to young (viviparity). Breeding usually takes place in the spring as many individuals disperse from a communal hibernating site, called a hibernaculum. Some snakes,

however, may also hibernate alone. They work their way under boulders piled up against power line poles, telephone and telegraph poles, and fence posts in damp places. They are also known to work their way down and against the foundations of buildings. J. Bernard Gilpin (1875) reports on the discovery of two hibernacula in his account of "The Garter Snake". He stated, "In my observation they seemingly never recognize each other, even of their own species, when even crossing each other's bodies in confinement, though others have informed me they have seen them coiled together in struggling groups during their breeding season or in torpid masses hybernating [sic]."

He then quotes the *Kentville Farmer* (1875). "Two men ploughing in a field near Kentville, rooted up a large stump, under which they found a coil of snakes numbering forty-five, in a torpid state." Gilpin's second report of a hibernaculum is as follows, "Mr. Stayner of Halifax, informed me that early in October, near town, in passing an ant-hill he pushed his cane into it and forced out a torpid snake. Returning to the spot he turned out above sixty of various sizes and species including *E. sirtalis* [Maritime Garter Snake], *C. vernalis* [Eastern Smooth Green Snake], *D. punctatus* [Northern Ringneck Snake] and *E. occipitomaculatus* [Northern Redbelly Snake], a common instinct seemingly bringing all species together."

Some birds, including the Great Blue Heron, Red-tailed Hawk, Rough-legged Hawk and American Kestrel, and some of the larger mammals, including Red Fox, Raccoon and Black Bear, are known predators on snakes but reptiles in general apparently make up a very small percentage of their total diet. Brook Trout and Smallmouth Bass housed in aquariums will eat small snakes and no doubt they will do so under natural conditions if they have the opportunity.

Perhaps the most significant predator is the domestic cat. These relentless hunters are effective in controlling small rodents in a house or barn, but they also destroy a great variety of animals which are beneficial. For example, the main diet of the Eastern Smooth Green Snake is moth larvae and some of these larvae are destructive to crops. Domestic cats, however, destroy many of these snakes annually. Over a period of 45 minutes on October 12, 1969, three adult Eastern Smooth Green Snakes were taken from a domestic cat in a field near Lady Hammond Road, Halifax.

Ornithologists do not regard the American Robin as a predator on snakes, but an interesting observation of American Robin predation on a snake was reported by James Harding, Milton, Queens County. He stated, "I was driving home on Route 8 between South Brookfield and Milton one afternoon during the summer of 1970, when I noticed a robin in difficulty at the edge of the pavement. I stopped to investigate and saw a large grass snake was wrapped around the robin. The robin was holding the snake by the neck in its beak. The robin suddenly released its hold on the snake and the snake released its grip on the robin. The robin flew a short distance in the woods and the snake continued to cross the highway. The robin, however, returned and attacked the snake by continually pecking at it and finally disabled it. The robin then flew off in the woods with the limp snake held in its beak." I observed an American Robin killing a young Maritime Garter Snake by repeatedly pecking at it on the shore of McCabe Lake, Halifax County, in August 1969.

Brown and Redbelly Snakes

Genus *Storeria*

The Brown and Redbelly Snakes are closely related to the Garter Snakes. However, they are smaller, lack a loreal plate, have a divided anal scale and generally are more secretive in their habits. This genus consists of two species, the Brown Snake, ***Storeria dekayi***, which is a complex of five sub-species, and the Redbelly Snake, *Storeria occipitomaculata*, which is a complex of three sub-species. Both species are native to eastern North America. The Northern Redbelly Snake, ***Storeria o. occipitomaculata***, represents the genus in the Maritime Provinces.

Northern Redbelly Snake

Storeria occipitomaculata occipitomaculata (Storer)

Variation

COLOUR

The diversity of colour and pattern of the Northern Redbelly Snake is complex. An individual can be olive-brown, tan-brown, chestnut-brown, greyish-brown, brownish-grey, grey or black on the back and sides of the trunk and tail. When examined closely, however, the colour is rarely one uniform shade but includes three subtle shades which make up a striped pattern. Characteristics of each colour phase are three fawn-brown spots evenly spaced across the back of the neck. These neck spots, often referred to as occipital spots, earned the Northern Redbelly Snake the specific name *occipitomaculata*. Occasionally an individual is found lacking the mid-neck spot or with the neck-spots fused to form a neck-band. The top and upper sides of the head of each colour phase are mottled with tan-brown, chestnut-brown, grey and black spots. The lower sides of the head, chin and underside of the neck vary from white to pale orange-cream with small black spots. The underside of the trunk and tail is orange to orange-red, bordered on both sides by a dark mottled stripe consisting of bluish-grey, black and orange flecks.

SCALATION

Northern Redbelly Snakes have keeled dorsal scales and a divided anal scale. There are 15 dorsal rows throughout most of the trunk length. Usually there are 17 scale rows on the neck but the number of rows is reduced to 15 at a point above and between the first and fifth ventral scales. The reduction is due to the loss of the second dorsal scale row on each side.

The ventral scales numbered from 110 to 125 (mean 116.0) in 115 males from 112 to 127 (mean 120.3) in 139 females (Figure 127). The subcaudal scales numbered from 43 to 52 (mean 47.8) in 101 males and from 36 to 49 (mean 43.3) in 130 females (Figure 128).

There are usually two preocular scales and two postocular scales on each side (Table 19). There are usually six supralabial scales and seven infralabial scales on each side (Table 20).

Table 19:
Ocular scale counts for 205 Northern Redbelly Snakes from Nova Scotia

Ocular Scales	Left Side/Right Side			
	1/1	1/2	2/1	2/2
Preoculars No. of Individuals	1	2	—	202
Postoculars No. of Individuals	10	9	15	171

Table 20:
Labial scale counts for 201 Northern Redbelly Snakes from Nova Scotia

Labial Scales	Left Side/Right Side								
	5/5	5/6	6/5	7/5	6/6	6/7	7/6	7/7	7/8
Supralabials No. of Individuals	1	3	1	—	184	7	2	3	—
Infralabials No. of Individuals	—	2	3	1	32	22	17	121	3

LENGTH OF YOUNG

The total length of 47 new-born young Northern Redbelly Snakes, born in captivity, ranged from 76 to 106 mm. The total length of 10 young captured in the field ranged from 85 to 110 mm (Table 21).

LENGTH OF ADULTS

The body length of 78 males ranged from 152 to 238 mm while that of 114 females ranged from 151 to 256 mm. The total length of 73 males ranged from 200 to 298 mm; 113 females ranged from 193

Table 21:
Length measurements in millimetres of 260 Northern Redbelly Snakes from Nova Scotia

No. of Individuals, Maturity, Sex, Recorder, Years collected	Body Length Range (Mean)	Total Length Range (Mean)	Tail Length as % of Total Length Range (Mean)
47 young born in captivity J. Gilhen, 1977		76.0-106.0 (86.6)	
10 young captured in the field J. Gilhen, 1969-1977		85.0-110.0 (98.6)	
1 adult male H. Piers, 1904		222.0	
3 adult males J. S. Bleakney, 1950		244.5-276.2 (259.8)	
46 (40)* adult males J. Gilhen, 1969-1980	155.0-238.0 (186.8)	200.0-298.0 (237.3)	20.1-24.9 (22.7)
32 (29)* adult males W. Weller & J. Gilhen 1971	152.0-215.0 (185.0)	200.0-280.0 (240.5)	21.8-24.6 (23.4)
2 adult females H. Piers, 1904-1915		239.0-247.0 (243.0)	
5 adult females J. S. Bleakney, 1950		222.3-276.2 (236.6)	
95 (89)* adult females J. Gilhen, 1969-1980	155.0-256.0 (195.1)	194.0-313.0 (241.0)	17.3-22.1 (19.5)
19 (17)* adult females W. Weller & J. Gilhen, 1971	151.0-231.0 (196.9)	193.0-284.0 (244.2)	18.1-23.9 (20.1)

*The numbers in parentheses represent the number of individuals measured for tail and total length.

to 313 mm. The tail length represented from 20.1 to 24.9 per cent of the total length in the 73 males with complete tails and from 17.3 to 23.9 per cent in the 113 females (Table 21).

Figure 127.

Number of ventral scales on 254 Northern Redbelly Snakes from Nova Scotia (115 males and 139 females)

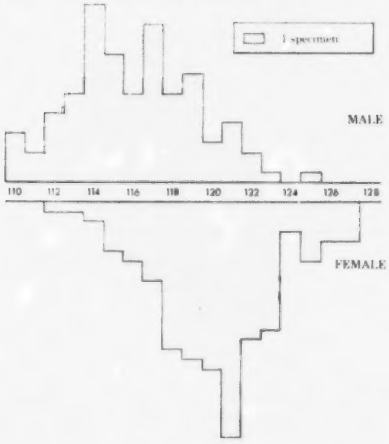
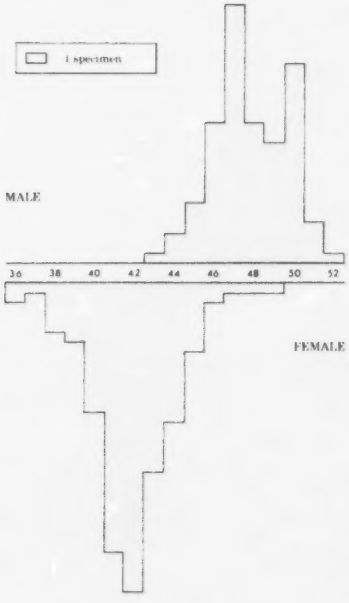


Figure 128.

Number of subcaudal scales on 231 Northern Redbelly Snakes from Nova Scotia (101 males and 130 females)



Distribution

In Canada the Northern Redbelly Snake ranges from Nova Scotia to south-central Saskatchewan. In the United States it ranges south to central Florida, west to the eastern parts of Kansas, Oklahoma and Texas, with a disjunct population in South Dakota and Wyoming. In Nova Scotia this species is widespread on the mainland and Cape Breton Island (Figure 129).

Habitat

Northern Redbelly Snakes are common in grassy and grassy-heath habitats along the shores of lakes, ponds and streams. They are particularly common along roadsides (Figure 130), cut-over areas, railroad rights-of-way and abandoned gravel pits, as well as along the margins of old fields, heath barrens and blueberry fields adjacent to deciduous, mixed or coniferous woods.

Natural History

Northern Redbelly Snakes surface from their subterranean places of hibernation in spring. The earliest record is April 13, 1980, when two adults were observed between 1330 and 1630 hrs on a grassy farm road adjacent to an old field and meadow at New Ross, Lunenburg County.

These snakes take shelter during most of the daylight hours under rocks, bark from fallen trees (Figure 131) and discarded materials such as boards, cardboard, tarpaper and metal objects such as doors from automobiles. They move out

Figure 129.

Distribution of the Northern Redbelly Snake in Nova Scotia

from under these surface materials during the evening, or earlier on cloudy and overcast days (Figure 132) and remain active throughout the night. On a warm, misty morning, from 0300 to 0530 hrs August 19, 1973, along approximately 32 km of Route 8, between South Brookfield and Milton, Queens County, 47 adults were observed on the highway; 42 of them were either dead or nearly so as a result of the automobile traffic.

Based on the embryos counted in 81 preserved females, Northern Redbelly Snakes produce a litter of from 3 to 12 (mean 7.4) young each year of pregnancy. The females bear their young during August and the first half of September.

The diet of Northern Redbelly Snakes consists of slugs. The slugs in the stomachs of 24 individuals

Figure 130.

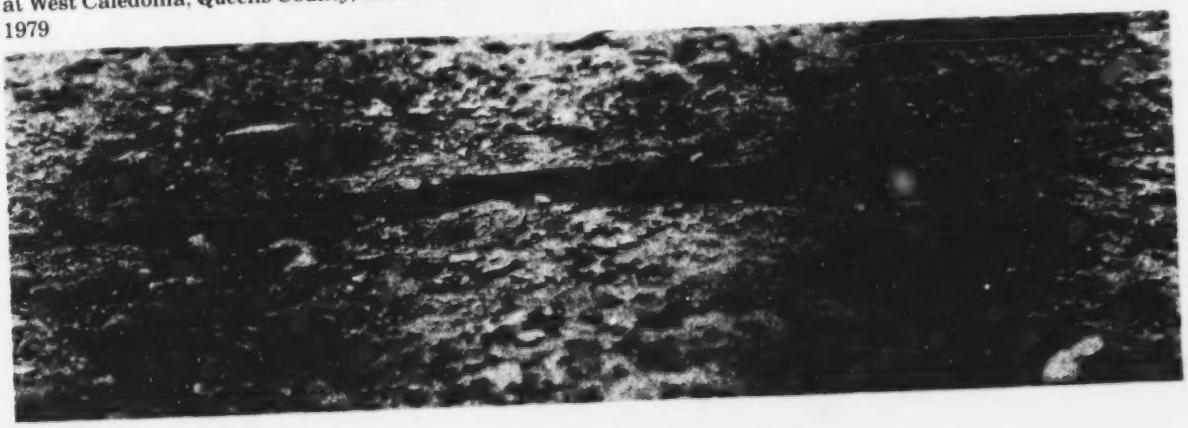
Bark from a fallen pine tree in deep grass at roadside, Colpton, Lunenburg County, where a Northern Redbelly Snake was found at 1024 hrs on July 12, 1978

Figure 131.

Adult female Northern Redbelly Snake observed under bark from fallen pine tree at Colpton, Lunenburg County, at 1024 hrs on July 12, 1978

Figure 132.

Adult female Northern Redbelly Snake on a gravel road at West Caledonia, Queens County, at 1725 hrs on May 8, 1979



were identified as to genus. It is interesting to note that two genera, *Deroceras* and *Arion*, which were introduced from Europe, were found in the stomachs of 23 individuals. Two *Phylomycus carolinianus*, a native slug, were found in the stomach of one individual from McCabe Lake, Halifax County. Northern Redbelly Snakes are of great value to the blueberry farmer because they feed on the slugs that damage the fruit. However, burning as a method of pruning the bushes would probably kill any snakes that resided in the fields.

Northern Redbelly Snakes retire to their places of hibernation during the autumn. The latest record is October 27, 1931.

Garter and Ribbon Snakes

Genus *Thamnophis*

The striped pattern on these snakes looks very much like the pattern on garters once fashionably worn by men to hold up their socks, hence the name "garter snake". Most species and sub-species of garter snake have a light dorsal stripe and two lateral stripes. The position of the lateral stripes is an important characteristic in distinguishing one species from another. Most garter snakes also have a dark checkerboard pattern.

The garter snakes and ribbon snakes are closely related to the Water Snakes, genus *Nerodia*. Water Snakes are not known from the Maritime Provinces at this time but adequate field investigations have not been carried out in southwestern New Brunswick, where the Northern Water Snake, *Nerodia sipedon sipedon*, may be discovered at some future date (personal communication from Dr. Stanley Gorham, New Brunswick Museum, Saint John).

The genus *Thamnophis* ranges from coast to coast from the southern North West Territories in Canada to Costa Rica. The Eastern Ribbon Snake is a complex of four sub-species, represented in Nova Scotia by the Northern Ribbon Snake, *Thamnophis sauritus septentrionalis*. The Eastern Garter Snake, *Thamnophis sirtalis* is a complex of seven sub-species, represented in the Maritime Provinces by the Maritime Garter Snake, *Thamnophis sirtalis pallidula*.

In the mid 1960s two captive Eastern Garter Snakes from the Ottawa area, Ontario, gave birth to a total of 60 young. These young snakes were released from a boat near Ritchie Island at Kejimkujik Lake. None of these young are believed to have reached the shore because they were heavily preyed upon by brook trout while swimming.

Northern Ribbon Snake

Thamnophis sauritus septentrionalis Rossman

Variation

COLOUR

Northern Ribbon Snakes are usually velvety-black on the back and sides of the head, trunk and tail (one individual was brownish-black) with a brownish-yellow stripe down the middle of the back and a greenish-yellow stripe on the lower sides. The dorsal stripe covers the middle scale row and overlaps on the adjacent scale rows while the lateral stripes cover the third and fourth scale rows on each side. When the skin is stretched, varying amounts of greenish-white are exposed between the black scales of the sides, and light yellowish-green is exposed between the greenish-yellow scales of the lateral stripes. On the top of the head there are two small, elongate greenish-yellow parietal spots and on the upper sides of the head there is a greenish-white band on the preocular scales. The lower postocular scales are also greenish-white. The lower sides of the head are greenish-

yellow, becoming paler on the chin and neck. There is a dark caramel-brown stripe below the light stripe down both sides of the abdomen and the underside of the tail. Each stripe covers approximately 20 per cent of the ventral surface and extends onto the first dorsal scale row. The remainder of the underside is a pale greenish-cream.

SCALATION

Northern Ribbon Snakes have keeled dorsal scales and an undivided anal scale. There are usually 21 dorsal scale rows on the neck but the number of rows is reduced to 19 at a point above and between the third and eighth ventral scales. The rows are reduced to 17 on the latter half of the trunk, at a point above and between the 72nd and 99th ventral scales, and remain at 17 rows above the last ventral scale. The reduction of rows is usually due to the loss of the fourth scale row on each side. Five out of 25 individuals examined lost the fifth row on one side of the neck. One individual had 23 dorsal scale rows on the neck but the rows were reduced to 21 and then to 19 above and between the third and sixth ventral scales.

The ventral scales numbered from 147 to 156 (mean 152.7) in nine males and from 148 to 156 (mean 152.4) in 17 females (Figure 133). The subcaudal scales numbered from 104 to 114 (mean 107.3) in seven males and from 95 to 102 (mean 99.4) in 11 females (Figure 134). There is one preocular scale and usually three postocular scales on each side. Two individuals out of 18 examined had three postocular scales on the left side and two on the right side. There are usually seven supralabial scales and 10 infralabial scales on each side (Table 22).

LENGTH OF YOUNG

The total length of seven newborn young, born in captivity, ranged from 191 to 210 mm (personal communication from Dr. Francis R. Cook, National Museum of Natural Sciences, Ottawa). The total length of a young female collected at Molega Lake, Queens County, September 6, 1976 was 202 mm (Table 23).

LENGTH OF ADULTS

The body length of six males ranged from 285 to 389 mm while that of eight females ranged from

Figure 133.

Number of ventral scales on 26 Northern Ribbon Snakes from Nova Scotia (9 males and 17 females)

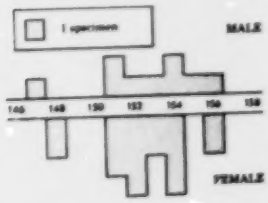


Figure 134.

Number of subcaudal scales on 18 Northern Ribbon Snakes from Nova Scotia (7 males and 11 females)

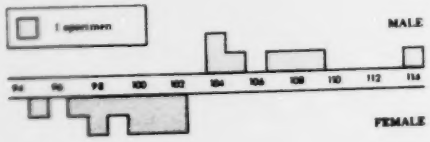


Table 22:
Labial scale counts for 27 Northern Ribbon Snakes from Nova Scotia

Labial Scales	Left Side/Right Side						
	6/6	7/7	7/8	8/7	8/8		
Supralabials No. of Individuals	1	20	1	4	1		
	8/9	9/9	8/10	9/10	10/9	10/10	11/11
Infralabials No. of Individuals	2	3	1	3	1	16	1

290 to 500 mm. The total length of six males ranged from 420 to 596.9 mm; eight females ranged from 412 to 725 mm. The tail length represents from 31.8 to 32.7 per cent of the total length in five of the males and from 29.6 to 30.9 per cent in five of the females (Table 23).

Distribution

The Northern Ribbon Snake ranges from southern Maine west to Vermont and southwest through northern New York to northern Indiana, penetrating into southeastern Illinois. Its distribution extends into southern Ontario and there is a disjunct relict population in southwestern Nova Scotia. The Nova Scotia population is centred in Queens County, with two localities in Lunenburg County (Figure 135).

Figure 135.

Distribution of the Northern Ribbon Snake in Nova Scotia

Table 23:
Length measurements in millimetres of 25 Northern Ribbon Snakes from Nova Scotia

No. of Individuals, Maturity, Sex, Recorder, Years collected	Body Length Range (Mean)	Total Length Range (Mean)	Tail Length as % of Total Length Range (Mean)
7 young born in captivity F. R. Cook, 1979		191.0-210.0 (198.7)	
1 young female captured in the field J. Gilhen, 1976		202.0	
1 adult male J. S. Bleakney, 1950		596.9	
6 (5)* adult males J. Gilhen, 1976-1981	285.0-389.0 (343.3)	420.0-570.0 (513.6)	31.8-32.7 (32.3)
2 adult females J. S. Bleakney, 1955		523.0-568.0 (545.5)	
7 (5)* adult females J. Gilhen, 1969-1981	290.0-468.0 (383.1)	412.0-670.0 (540.8)	29.6-30.9 (29.9)
1 adult female F. R. Cook, 1979	500.0	725.0	31.0

*The numbers in parentheses represent the number of individuals that were measured for tail and total length.

Habitat

Northern Ribbon Snakes seem to prefer the margins of quiet, vegetated ponds (Figure 136) and coves of lakes as well as grassy places along streams. The shoreline can be boggy or rocky; the main requirement seems to be an abundance of aquatic vegetation where they can take shelter and seek prey. Three individuals collected at Cranberry Cove, Molega Lake, September 1976 were active on the lawn of a lakeshore cottage.

Figure 136.

Densely vegetated roadside pond at Colpton, Lunenburg County, where Northern Ribbon Snakes were found during the spring and summer of 1978

Natural History

Northern Ribbon Snakes surface from their subterranean places of hibernation during the spring. The earliest record is April 23, 1978, when at 1105 hrs a juvenile male was collected in the shallows of a pond in a roadside gravel pit at Colpton, Lunenburg County.

Northern Ribbon Snakes are active during the day. They seem nervous when approached by humans, and individuals observed on the shore or on the surface in the shallows usually take shelter immediately, under the surface among the aquatic vegetation. While walking in the shallows of the pond at Colpton, between 1130 and 1230 hrs, July 12, 1978, I observed a juvenile male on the soft

Figure 137.

A juvenile male Northern Ribbon Snake poised to defend itself on the soft shore of a roadside pond at Colpton, Lunenburg County, between 1130 hrs and 1230 hrs on July 12, 1978

shore. This one was not so timid and when approached poised to defend itself (Figure 132). Bleakney (1951) reported that a beaver lodge served as a shelter for three adults he collected at Kempt, Queens County. He found a fourth adult among some beams at a sawdust pile at Caledonia.

Of four preserved females containing embryos, two had nine, one had six and one had 10. One female captured at Colpton on July 5, 1978, gave birth to a litter of seven on September 5, 1978.

Three out of 27 preserved Northern Ribbon Snakes had prey in their stomachs, including one juvenile Northern Leopard Frog, one juvenile frog (*Rana*) and a Red-spotted Newt larva.

Northern Ribbon Snakes retire to their places of hibernation during the autumn. The latest date recorded is October 2, 1966, when an adult female was collected at Ponhook Lake, Queens County.

Maritime Garter Snake

Thamnophis sirtalis pallidula Allen

Variation

COLOUR

Maritime Garter Snakes are extremely variable in colour and pattern. Bleakney (1959) narrowed the variation down to three main colour phases: cinnamon-brown on the back and sides, with the underside being colonial-buff anteriorly, becoming olive-buff posteriorly; yellowish-olive above with amber-yellow to tea-green below; and olive-grey above with olive-buff to French-grey below. There are usually two distinct rows of alternating square dark spots in a checkerboard pattern on each side. Some individuals have a distinct pale grey stripe down the back, but in others the top row of spots in the checkerboard pattern extends to or over the midline of the back and continually interrupts an olive-yellow or brown stripe. Below the bottom row of spots on the lower sides, there is a stripe which Bleakney described as cinnamon-buff on cinnamon-brown individuals, chamois on yellowish-olive ones and "greyish" on olive-grey ones. These light lateral stripes contrast with the ground colour above anteriorly but often become darker and indistinct posteriorly. There is a great deal of variation within each of these three phases and in Nova Scotia an additional black (melanistic) phase must be included. True melanistic individuals are uncommon. They are uniform black on the back and sides with a glossy white chin and throat, changing to dark slate-grey or bluish-black on the remaining underside. Melanistic young have not been found but some young adults have varying amounts of black pigment on the back and dark grey on the underside. The peculiar colour pattern of these individuals is commonly referred to as partially melanistic. Characteristic of all phases is a row of irregularly-shaped spots down both sides of the abdomen.

SCALATION

Maritime Garter Snakes have keeled dorsal scales and the anal scale is undivided. There are 23 or 21 dorsal scale rows on the neck, but the number of

Table 24:
Ocular scale counts for 210 Maritime Garter Snakes from Nova Scotia

Ocular Scales	Left Side / Right Side									
	1/1	2/1	1/2	2/2	2/3	3/2	3/3	3/4	4/3	4/4
Preoculars No. of Individuals	201	1	4	4						
Postoculars No. of Individuals	189			1	3	4		7	6	

rows is reduced to 19 usually above and between the third and sixth ventral scales. The rows are further reduced to 17 on the posterior half of the body, usually above and between the 68th and 83rd ventral scales, and usually remain at 17 rows, rarely 15, above the last ventral scale. Some individuals, however, alternate from 19 to 17 and back to 19 scale rows a number of times on the posterior half of the trunk. The reduction of scale rows is usually due to the loss of the fourth, rarely the third, scale row on each side. Individuals that have 23 scale rows on the neck lose the fifth row on each side and then the fourth row on each side to give a dorsal scale row count of 19.

The ventral scales numbered from 133 to 154 (mean 143.9) in 124 males and from 130 to 148 (mean 138.9) in 172 females (Figure 138). The subcaudal scales numbered from 56 to 71 (mean 64.1) in 109 males and from 50 to 64 (mean 56.6) in 141 females (Figure 139).

There are usually one, rarely two, preocular scales and three, rarely two or four, postocular scales (Table 24).

There are usually seven, rarely six or eight, supralabial scales and 10, rarely nine or 11, infralabial scales (Table 25).

Figure 138.

Number of ventral scales on 296 Maritime Garter Snakes from Nova Scotia (124 males and 172 females)

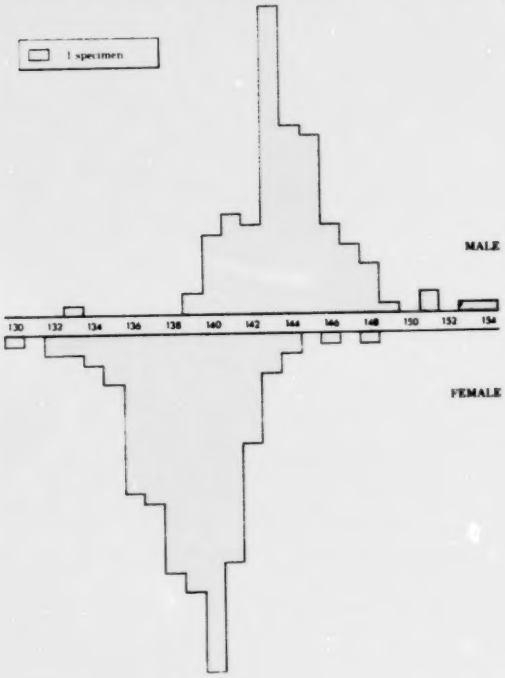


Figure 139.

Number of subcaudal scales on 250 Maritime Garter Snakes from Nova Scotia (109 males and 141 females)

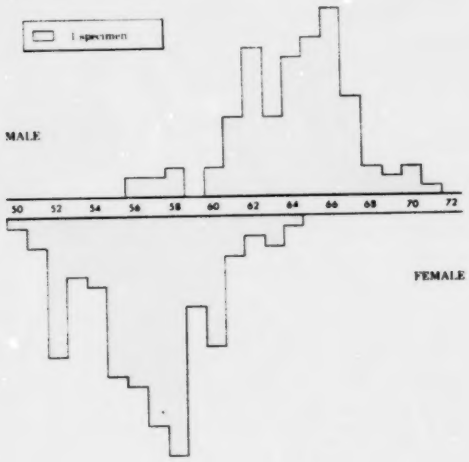


Table 25:
Labial scale counts for 210 Maritime Garter Snakes from Nova Scotia

Labial Scales	Left Side / Right Side						
	6/6	6/7	7/7	7/8	8/7	8/8	
Supralabials No. of Individuals	1	1	188	9	9	2	
	9/9	9/10	10/9	10/10	10/11	11/10	11/11
Infralabials No. of Individuals	7	8	9	173	6	4	3

LENGTH OF YOUNG

The total length of 139 newborn young, born in captivity, ranged from 134 to 190 mm (Table 26).

LENGTH OF ADULTS

The body length of 51 males ranged from 283 to 527 mm while that of 82 females ranged from 313 to 728 mm. The total length of 51 males ranged from 396 to 602 mm; 99 females ranged from 398 to 916.9 mm. The tail length represents from 18.7 to 26.6 per cent of the total length in 34 of the males and from 17 to 23.3 per cent in 68 of the females (Table 26).

Distribution

In Canada the Maritime Garter Snake is found from the Maritime Provinces through eastern Quebec. In the United States it is found in northwestern Maine and northern New Hampshire. In Nova Scotia this subspecies is widespread throughout the mainland and Cape Breton Island, including some of the larger coastal islands such as Big and Little Tancook Islands, Lunenburg County, and Port Hood Island, Inverness County (Figure 140).

Table 26:
Length measurements in millimetres of 320 Maritime Garter Snakes from Nova Scotia

No. of Individuals, Maturity, Sex, Recorder, Years collected	Body Length Range (Mean)	Total Length Range (Mean)	Tail Length as % of Total Length Range (Mean)
139 young W. Weller & J. Gilhen, 1969-1971		134-190 (165.7)	
17 adult males J. S. Bleakney, 1950		406.4-571.5 (484.9)	
28 (15)* adult males J. Gilhen, 1969-1980	302-515 (393.7)	406-575 (490.6)	20.9-24.7 (22.9)
23 (19)* adult males W. Weller & J. Gilhen 1971	283-527 (382.7)	396-602 (493.9)	18.7-26.6 (22.9)
9 adult females H. Piers, 1903-1927		603.3-916.9 (719.8)	
22 adult females J. S. Bleakney, 1950		412.8-749.3 (574.6)	
33 (30)* adult females J. Gilhen, 1969-1980	434-704 (526.7)	522-864 (632.6)	18.6-21.7 (20.2)
49 (38)* adult females W. Weller & J. Gilhen, 1971	313-728 (490.4)	398-744 (607.8)	17.0-23.3 (20.4)

*The number in parentheses represents the number of individuals which have a complete tail and were measured for tail and total length.

Habitat

Maritime Garter Snakes are common along the shores of ponds, lakes and streams, as well as the coastal shore above the high-tide mark. They are common in a variety of woodland and agricultural situations. They frequent rocky roadsides (particularly in grassy-heath areas), margins of heath barrens, blueberry fields, old fields, meadows, swamps, bogs, gravel pits, clearings surrounding abandoned mines, and around the foundation of farms, lake-shore cottages, camps and abandoned buildings.

Figure 140.

Distribution of the Maritime Garter Snake in Nova Scotia

Natural History

Maritime Garter Snakes emerge from their places of hibernation in spring. The earliest record is April 16, 1975, when one adult male was observed sunning on a flat rock along the roadside at Colpton, Lunenburg County. I am aware of two verbal reports of a Maritime Garter Snake being found dead on snow during the winter. Because this species is common in suburban areas, I attributed the phenomenon to unnatural conditions, such as an individual being disturbed from its place of hibernation during excavation of a frozen water pipe. John Wright, however, photographed a live adult Maritime Garter Snake lying on a snow-covered pond at 1530 hrs, February 20, 1974, at Smith's Cove, Digby County. He said there was no excavation going on in the area at that time. The photograph is on file at the Nova Scotia Museum.

Maritime Garter Snakes are the snakes most commonly seen by people because they are larger than the other common species native to the Mari-

Figure 141.

Large adult female Maritime Garter Snake basking in the sun on a gravel road, Glenelg, Guysborough County, at 1320 hrs on July 27, 1978

time Provinces and they are active during the day in a variety of habitats, some of which are close to human dwellings. Because they are frequently encountered by people, practically all exaggerated stories about snakes in our area can be attributed to Maritime Garter Snakes. They are often seen in water or near barns, and so have been incorrectly identified as water snakes and milk snakes. The square spots on the back are mistaken for diamond-shaped spots by some people who report seeing diamond-backed snakes.

Maritime Garter Snakes will remain in a given area as long as food, shelter and open places for sunning are available. People often report seeing the same snake at about the same time each sunny day during the summer on their lawn, woodpile, driveway, patio or some other conspicuous place at camps, cottages or homes. On July 25, 1973, at 1500 hrs, 15 adult females were captured inside a tarpapered shack used as a fishing and hunting camp at West Branch Economy River, Colchester County. They were all stretched out, two on the floor, five on the bottom bunk, two on the top bunk, five on the woodpile and one on an open top shelf. They were apparently taking advantage of the much warmer temperature inside the shack for embryo development. Often when Maritime Garter Snakes start to cross a road they will remain on the road to bask in the sun (Figure 141).

Maritime Garter Snakes are excellent swimmers. They have been observed in fresh water lakes 100 metres or more from shore. John Matthew Jones (1865) mentioned, "It is apparently a good swimmer, for the Rev. John Ambrose informs me that it has been observed a mile or more from the shore at the entrance to St. Margaret's Bay, making for the islands outside."

There seems to be a tendency for them to become numerous on islands. For example, there are dense populations on McNab's and Lawlor's Islands, Halifax Harbour, Halifax County. Fred Scott reported that he had seen three individuals in an area of about 100 square feet over a period of five minutes near a house on Little Tancook Island, Mahone Bay, Lunenburg County, on July 9, 1979, despite the fact that some young people in the area had apparently killed over one hundred snakes the previous week.

Based on the embryos counted in 50 females, Maritime Garter Snakes produce from six to 40 young (mean 15.9) each year of pregnancy. The young ones are born from early August to about mid-September.

Maritime Garter Snakes prey on a variety of small animals. Earthworms and the Eastern Redback Salamander are the most important food of juvenile individuals, but small fishes, the Yellow-spotted Salamander, Eastern American Toad, Green Frog, Northern Leopard Frog and Wood Frog are also important prey of adults. An adult female from McCabe Lake had eaten a small nestling bird. Fred Scott reported that in July 1979 Maritime Garter Snakes were the most important vertebrate predator of meadow voles, *Microtus*, on Little Tancook Island.

Maritime Garter Snakes retire to their places of hibernation during the autumn. The latest record is October 29, 1935, when one individual was captured at East Roman Valley, Guysborough County.

Ringneck Snakes

Genus *Diadophis*

These are small, secretive woodland snakes. *Diadophis punctatus*, the only species belonging to the genus, is a complex of 12 subspecies. Their combined distribution extends from southeastern Canada to eastern and southern United States and penetrates far south into Mexico with disjunct populations in the far west, from the northern United States to northern Mexico.

Most subspecies of Ringneck Snakes are characterized by a yellowish-orange band across the back of the neck which may be complete or incomplete. Most individuals of the Regal Ringneck Snake, *D. p. regalis*, are an obvious exception in that they lack the neck bank.

The presence or absence of spots and the pattern, or arrangement, of spots on the underside of the head, trunk and tail, as well as the number of ventral and subcaudal scales and number of dorsal scale rows, are important characteristics in distinguishing one subspecies from another.

The Northern Ringneck Snake, *Diadophis punctatus edwardsi*, represents the Ringneck Snake complex in the Maritime Provinces. It is interesting to note that many individuals from Nova Scotia have a spotted pattern on the underside which is similar to that of the Southern Ringneck Snake, *D. p. punctatus*, the Mississippi Ringneck Snake, *D. p. stictogenys*, and the Prairie Ringneck Snake, *D. p. arnyi* (Figure 142).

Northern Ringneck Snake

Diadophis punctatus edwardsi (Merrem)

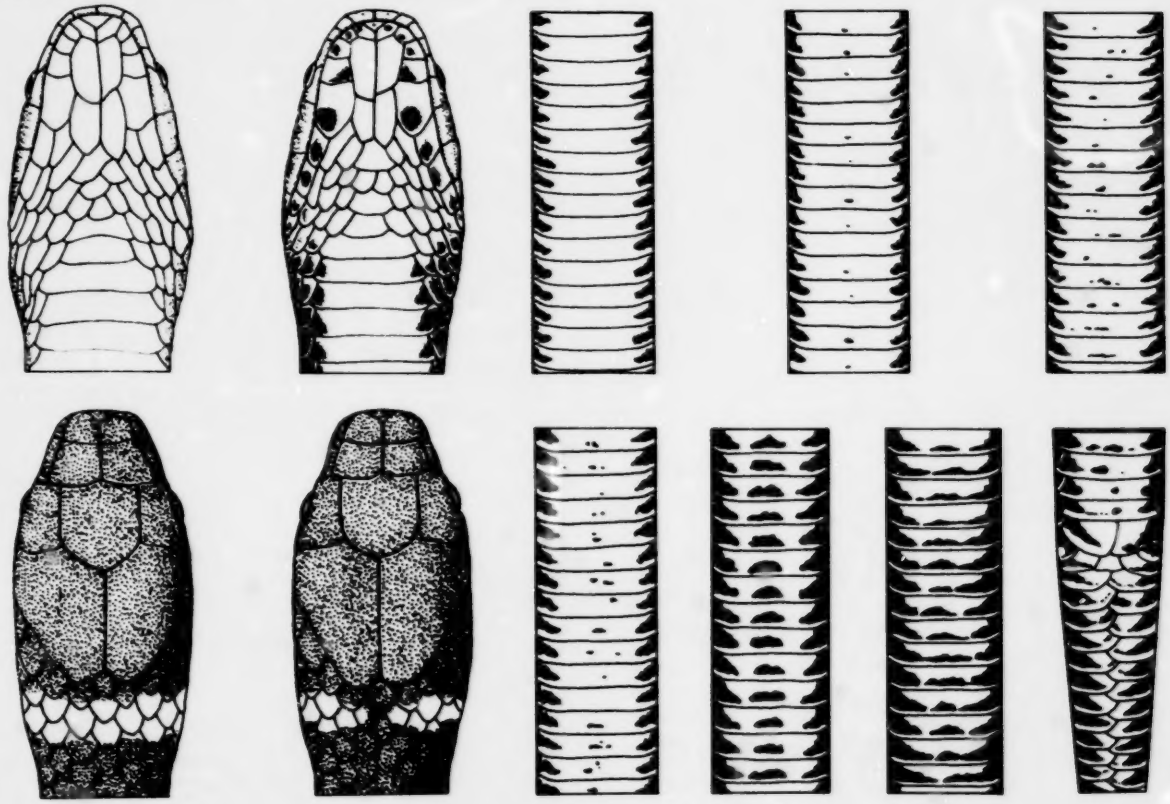
Variation

COLOUR

The Northern Ringneck Snake, as its name implies, has a yellowish-orange band across the back of the neck. The band is usually one to two and a half scales in width. On rare occasions an individual is found with an incomplete neck-band (Figure 142). The top and upper sides of the head are

Figure 142.

Mid ventral, mid subcaudal and infralabial spotting and neck ring variation in Northern Ringneck Snakes from Nova Scotia



black and there is also a black posterior border to the neck-band. The back and sides of the trunk and tail are usually a bluish-slate-grey or greyish-black. Some individuals are light cinnamon-brown anteriorly, gradually changing to slate-grey towards the tail. The lower sides of the head and the underside of the head, abdomen and tail vary from yellowish-orange to reddish-orange and are palest on the chin and neck. On each side of the ventral scales, anal plate and subcaudal scales there is a black spot which is often wedge-shaped. These spots may be obscure or absent on the first few ventrals. The tip of the tail is greyish-black. The infralabial scales, mid-ventral area and mid-subcaudal area may be immaculate or have varying amounts of black spotting (Figure 142).

SCALATION

Northern Ringneck Snakes have smooth dorsal scales and a divided anal scale. There are 15 dorsal scale rows throughout most of their body length. There may be 17 rows on the neck but the number of rows is reduced to 15 at a point above and between the second and third ventral scales. The reduction in rows is due to the loss of the third row on both sides.

The ventral scales numbered from 140 to 162 (mean 150.5) in 117 males and from 151 to 167 (mean 157.9) in 117 females (Figure 143). The subcaudal scales numbered from 50 to 65 (mean 58.4) in 105 males and from 46 to 62 (mean 53.4) in 97 females (Figure 144).

There are usually two preocular scales and two postocular scales on both sides (Table 27).

There are usually eight supralabial scales and eight infralabial scales on both sides. However, individuals having seven supralabials or seven infralabials are not uncommon (Table 28).

LENGTH AND WIDTH OF EGGS

A total of 37 eggs was removed from a communal nest and measured. The length ranged from 21 to

Figure 143.

Number of ventral scales on 234 Northern Ringneck Snakes from Nova Scotia (117 males and 117 females)

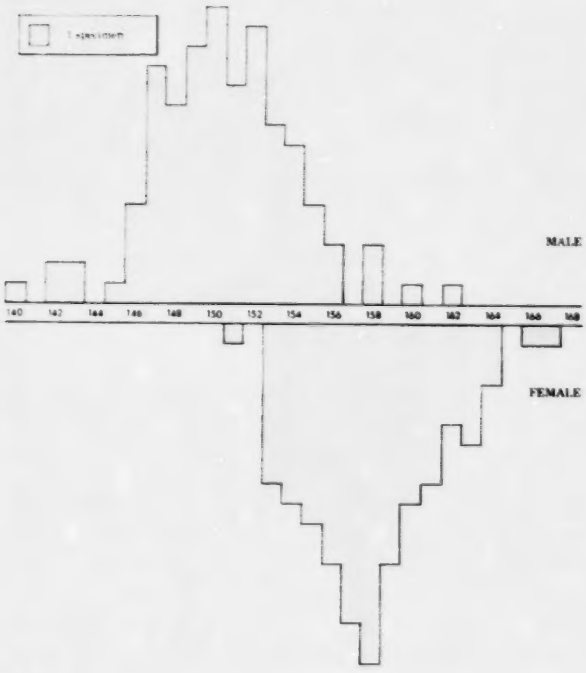
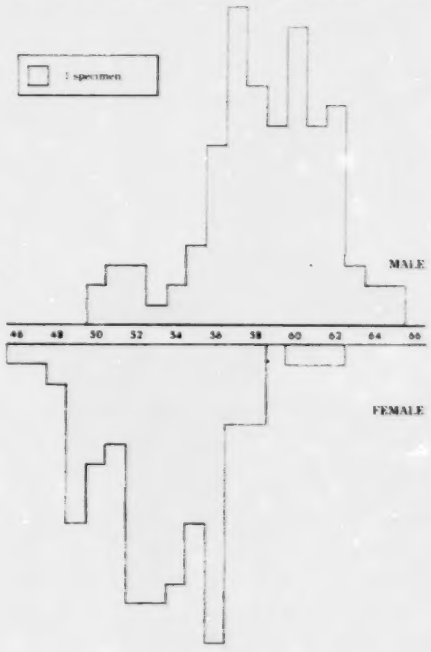


Figure 144.

Number of subcaudal scales on 202 Northern Ringneck Snakes from Nova Scotia (105 males and 97 females)



36 mm and the greatest width ranged from 9 to 12 mm.

LENGTH OF NEWLY HATCHED YOUNG

The total length of 37 young newly hatched, from eggs incubated artificially, ranged from 103 to 124 mm, while that of 21 hatchlings collected in the field ranged from 119 to 131 mm (Table 29).

LENGTH OF ADULTS

The body length of 69 males ranged from 206 to 315 mm while that of 82 females ranged from 204 to 432 mm. The total length of 56 of these males ranged from 279 to 411 mm; 66 of the females ranged from 259 to 543 mm. The tail length represented from 20.5 to 26.8 per cent of the total length in 55 of the males and from 18.4 to 24.1 per cent in 62 of the females (Table 29).

Distribution

The range of the Northern Ringneck Snake extends from Nova Scotia west to Wisconsin and south through the uplands to northern Georgia and in the Mississippi Valley to Illinois. In Nova Scotia it is common in the southwestern and eastern mainland, including Big Tancook Island, Mahone Bay, Lunenburg County, with two localities in northern Cape Breton Island (Figure 145). The bedrock in these areas is granite, slate and greywacke of the Meguma series.

Figure 145.

Distribution of the Northern Ringneck Snake in Nova Scotia

Table 27:
Ocular scale count of 157 Northern Ringneck Snakes from Nova Scotia

Ocular Scales	Left Side / Right Side						
	1/1	1/2	2/1	2/2	1/2	3/2	3/3
Preoculars No. of Individuals	6			143	6	1	1
Postoculars No. of Individuals		1	1	152	2	1	

Table 28:
Labial scale counts of 155 Northern Ringneck Snakes from Nova Scotia

Labial Scales	Left Side / Right Side						
	7/6	8/6	7/7	7/8	8/7	8/8	8/9
Supralabials No. of Individuals			25	12	20	95	3
Infralabials No. of Individuals	3	1	42	9	19	80	1

Table 29:
Length measurements in millimetres of 214 Northern Ringneck Snakes from Nova Scotia

No. of Individuals, Maturity, Sex, Recorder, Years collected	Body Length Range (Mean)	Total Length Range (Mean)	Tail Length as % of Total Length Range (Mean)
19 male hatchlings incubated in the laboratory, J. Gilhen, 1969		103.0-122.0 (113.8)	
9 male hatchlings collected in the field, J. Gilhen, 1969		121.0-129.0 (124.1)	
18 female hatchlings incubated in the laboratory, J. Gilhen, 1969		107.0-124.0 (112.2)	
12 female hatchlings collected in the field, J. Gilhen, 1969		119.0-131.0 (124.6)	
1 adult male H. Piers, 1926		368.3	
41 (32)* adult males J. Gilhen, 1969-1980	206.0-312.0 (256.5)	279.0-411.0 (336.8)	22.3-26.8 (24.3)
28 (23)* adult males W. Weller & J. Gilhen 1971	213.0-315.0 (272.5)	284.0-404.0 (354.8)	20.5-25.6 (23.7)
1 adult female H. Piers, 1923		462.3	
3 adult females J. S. Bleakney, 1950		317.5-346.1 (329.2)	
61 (47)* adult females J. Gilhen, 1969-1980	204.0-432.0 (276.7)	259.0-543.0 (343.2)	18.4-23.8 (21.3)
21 (15)* adult females W. Weller & J. Gilhen 1971	207.0-331.0 (278.5)	278.0-432.0 (345.2)	19.8-24.1 (21.6)

*The numbers in parentheses represent the number of individuals that were measured for tail and total length.

Figure 146.

Grasses, ericaceous shrubs and ferns along the roadside at Colpton, Lunenburg County, where Northern Ringneck Snakes were common during the summer of 1978

Habitat

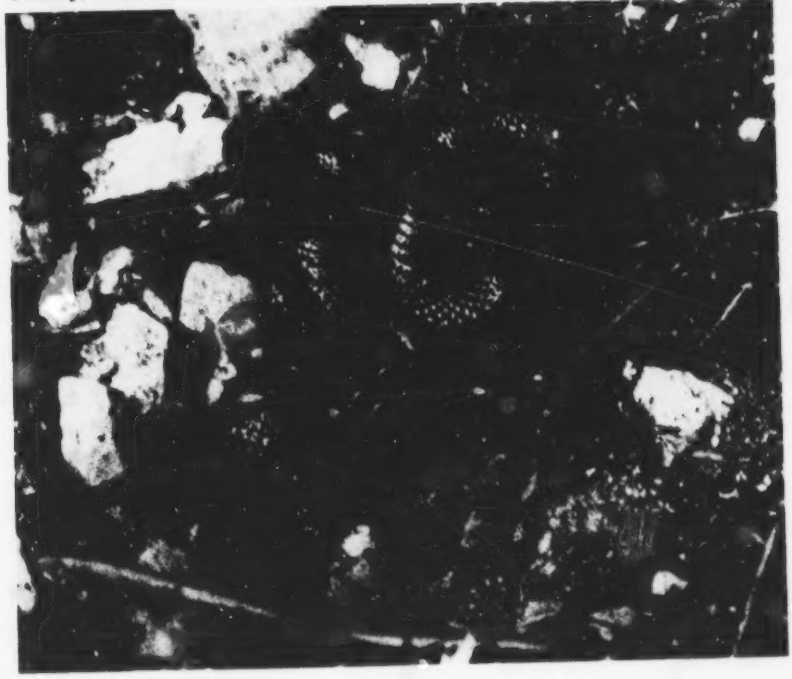
The Northern Ringneck Snake is a woodland species. It is most common in deciduous and mixed woods, particularly near the shores of ponds, lakes and streams and at the edge of old heath bogs, fields and gravel pits and along roadsides where grasses, ericaceous shrubs and ferns are the dominant vegetation (Figure 146).

Natural History

Northern Ringneck Snakes emerge from their subterranean places of hibernation in spring. The earliest record is May 7, 1972, when an adult female was found under a rock along the roadside near Donnellan Lake, Queens County. However, they are notorious for travelling along the face of foundations of buildings and hibernating there. An adult female was dug out of hibernation about one and one-half metres beneath the surface next to the foundation of a house at Westphal, Halifax County, on February 1, 1964. The radiation of heat from a heated building probably causes snakes that are

Figure 147.

Northern Ringneck Snake found when a piece of slate was turned over on the roadside at Colpton, Lunenburg County, at 1600 hrs on July 5, 1978



hibernating in such situations to become active earlier in the season. There are a number of reports of one of these snakes finding its way inside a building. For example, on March 3, 1975, a small juvenile was found alive in the hallway of an apartment at Crystal Heights, Dartmouth, Halifax County.

Northern Ringneck Snakes have been found during the day under rocks (Figure 147), loose bark of stumps and fallen trees and within damp logs. Two adults were found inside a damp log at Minard Brook, Queens County, at 0830 hrs May 29, 1971. The log had to be completely pulled apart in order to extract them as they had travelled through tunnels mined out by a colony of ants which had previously occupied the log. These snakes will also take cover under boards or other discarded materials.

Northern Ringneck Snakes move out from their daytime retreats at dusk. This snake has frequently been observed crossing roads at night. On two occasions, at 0030 hrs, June 4, 1964, and 2155 hrs, June 28, 1976, at Minard Brook, Queens County, adult Northern Ringneck Snakes were captured by means of a dip net and flashlight as they were swimming across this stream.

Based on the egg counts of 43 preserved females, Northern Ringneck Snakes produce from one to eight eggs each year (Figure 148). Females deposit their yellowish-white eggs in damp places, under rocks or rotting wood, in open areas where the surface is exposed to the sun, during late June to early July. Usually the eggs are stuck together and lie against the fine rootlets of vegetation. Often a number of females will congregate at a suitable site and lay their eggs in a communal nest (Figure 149). On September 24, 1972, a communal nest containing 117 eggs in a conical mass was discovered when a large quartzite boulder was turned over in an open area near the north shore of McCabe Lake, Halifax County. The average female produces from three to four eggs (Figure 148) and therefore this mass of eggs was probably produced by 29 to 39 gravid females depositing their eggs in that place. The eggs hatch some time between late August and early October.

The diet of the Northern Ringneck Snake consists largely of Eastern Redback Salamanders. One adult male from Jordan River, Shelburne County, had eaten a young Northern Redbelly Snake and an adult male from McCabe Lake, Halifax County, had eaten a hatchling Eastern Smooth Green Snake.

Northern Ringneck Snakes retire to their places of hibernation during the autumn. The latest record is October 12, 1970, when 19 hatchlings and one juvenile were discovered within a pile of greywacke tailings close to the entrance of an abandoned gold mining pit near Little Gammon Lake, Halifax County.

Figure 148.

Number of eggs produced by 43 female Northern Ringneck Snakes from Nova Scotia

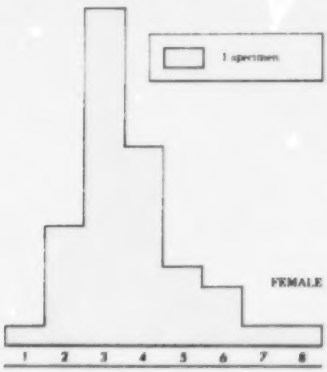


Figure 149.

Northern Ringneck Snake communal nesting site at the north end of McCabe Lake, Halifax County

Green Snakes

Genus *Opheodrys*

This genus ranges from Nova Scotia west to the Rocky Mountains in Canada and south to Florida and northern Mexico. The genus consists of two species, the Rough Green Snake, *Opheodrys aestivus*, and the Smooth Green Snake, *Opheodrys vernalis*. The Rough Green Snake is a southern species with keeled dorsal scales and is popularly called vine snake because it frequents vines and shrubs. The Smooth Green Snake is a northern species which has smooth dorsal scales and is commonly called grass snake because it frequents grassy places. Both species are skillful climbers and their green colour blends remarkably well with their respective habitats.

The Smooth Green Snake is a complex of two subspecies, the Eastern Smooth Green Snake, *O. v. vernalis*, and the Western Smooth Green Snake, *O. v. blanchardi*. The eastern subspecies has 130 or fewer ventral scales in the male and 139 or fewer in the female. The western subspecies has 131 or more ventral scales in the male and 140 or more in the female.

The Eastern Smooth Green Snake represents the genus in the Maritime Provinces.

Eastern Smooth Green Snake

Opheodrys vernalis vernalis Harlan

Variation

COLOUR

Eastern Smooth Green Snakes are easily distinguished by their plain satiny green colour. The back and upper sides of the head, trunk and tail vary from grass-green to yellowish-green. The lower sides of grass-green individuals are pale, becoming greenish-white on the underside. The lower sides of yellowish-green individuals are pale yellow, becoming yellowish-white on the underside.

SCALATION

Eastern Smooth Green Snakes have smooth dorsal scales and a divided anal scale. There are 15 dorsal scale rows throughout most of the trunk length. Usually there are 17 dorsal scale rows on the neck, but the number of rows is reduced to 15 at a point above and between the second and fourth ventral scales, rarely between the fourth and sixth ventral scales. The reduction in rows is due to the loss of the third row of scales on each side.

The ventral scales numbered from 108 to 124 (mean 117.1) in 114 males and from 117 to 131 (mean 125.2) in 126 females (Figure 150). The subcaudal scales numbered from 66 to 85 (mean 78.5) in 105 males and from 59 to 77 (mean 67.3) in 116 females (Figure 151).

There is usually one preocular scale, but individuals having two preoculars are not uncommon. There are usually two postocular scales, and individuals having one or three are rare (Table 30).

There are usually seven supralabial scales, but on rare occasions an individual has six supralabials on one side. There are usually seven infralabial scales, but occasionally an individual has six, rarely five or eight infralabials (Table 31).

LENGTH OF EGGS

A total of 93 eggs was removed from nesting sites and 41 of these eggs were measured. The total length ranged from 19 to 37 mm and the greatest diameter ranged from 9.5 to 13.5 mm.

LENGTH OF NEWLY HATCHED YOUNG

A total of 93 eggs was artificially incubated and the newly hatched young, which were greyish-green, ranged from 96 to 129 mm in total length (Table 32).

LENGTH OF ADULTS

The body length of 50 males ranged from 197 to 289 mm while that of 75 females ranged from 212 to 318 mm. The total length of 52 males ranged from 300 to 444 mm; 72 females ranged from 304 to 449 mm. The tail length represented from 29.9 to 36.3 per cent of the total length in the 49 males with a complete tail and from 24.9 to 32.3 per cent in the 71 females (Table 32).

Distribution

In Canada the Eastern Smooth Green Snake ranges from Nova Scotia west to western Ontario. (Apparently the populations in Manitoba and Saskatchewan are intermediate between the eastern and western subspecies.) The range of this snake extends south in the United States to southwestern Virginia with a disjunct population in extreme southwestern Virginia at the western border of

Figure 152.

Distribution of the Eastern Smooth Green Snake in Nova Scotia

Figure 150.

Number of ventral scales on 240 Eastern Smooth Green Snakes from Nova Scotia (114 males and 126 females)

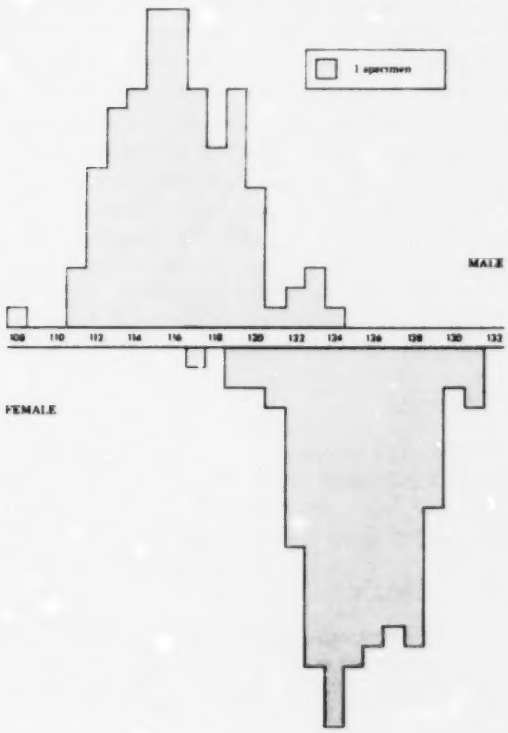
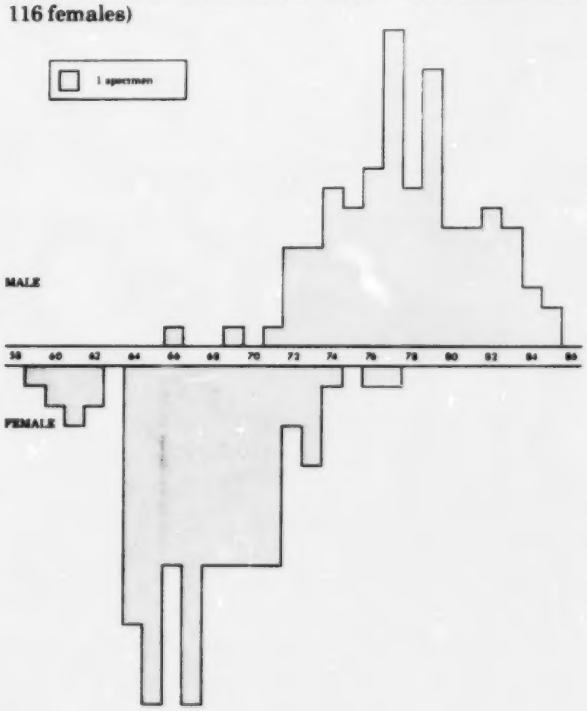


Figure 151.

Number of subcaudal scales on 221 Eastern Smooth Green Snakes from Nova Scotia (105 males and 116 females)



North Carolina. In Nova Scotia it is widespread throughout the province (Figure 152).

Habitat

Eastern Smooth Green Snakes inhabit grassy and shrubby areas along the shores of ponds, lakes and streams. They are particularly common along grassy-heath-fern roadsides (Figure 153) and in old fields. In barren coastal areas they are also found in grass near sphagnum, cranberry and old heath bogs. This species will also frequent lawns and gardens in suburban areas.

Natural History

Eastern Smooth Green Snakes usually emerge from their subterranean places of hibernation in May. The earliest record is May 3, 1884, when an adult male was captured at Berwick, Kings County.

Most people are familiar with these snakes because they are active during the day and are common in areas frequented by people. They rarely attempt to bite. Young people camping, spending time at cottages or living in suburban areas capture them and take them to school, or try unsuccessfully to keep them as pets. They are difficult to keep captive for long periods of time because they usually refuse to eat.

Figure 153.

Grassy roadside at Colpton, Lunenburg County, where seven Eastern Smooth Green Snakes were observed between 1500 and 1620 hrs on July 5, 1978

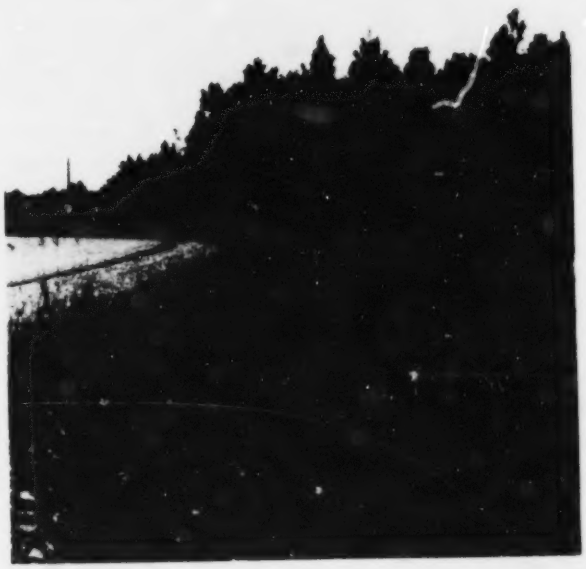


Table 30:
Ocular scale counts of 110 Eastern Smooth Green Snakes from Nova Scotia

Ocular Scales	Left Side / Right Side				
	1/1	1/2	2/1	2/2	2/3
Preoculars No. of Individuals	82	5	8	15	
Postoculars No. of Individuals		1		107	2

Table 31:
Labial scale counts of 110 Eastern Smooth Green Snakes from Nova Scotia

Labial Scales	Left Side / Right Side								
	5/6	6/5	6/6	6/7	7/6	7/7	7/8	8/7	8/8
Supralabials No. of Individuals				3	1	106			
Infralabials No. of Individuals	1	1	3	3	1	92	5	2	2

Eastern Smooth Green Snakes blend remarkably well with grassy habitats and move rapidly to escape when approached by noisy, unsuspecting persons. However, it is possible to see them from a short distance and if approached slowly and quietly they can be observed close up and photographed (Figure 154). During a mild, cloudy afternoon, between 1800 and 1900 hrs, June 20, 1973, over 200 Eastern Smooth Green Snakes were seen in grassy areas at the edge of old heath bogs at the side of a gravel road leading to Lake John, Shelburne County. Many were active in the grass while many others lay against or under granite boulders.

Eastern Smooth Green Snakes are superb climbers in vegetation. Sometimes when an individual is captured and then released it will climb a shrub rather than take shelter under a rock. At 1000 hrs, September 2, 1980, an adult female was seen draped over the flowering parts of tall white aster and goldenrod about 130 cm above the ground, in an old field at Harrietsfield, Halifax County. Its head gently swayed from side to side while the rest of its body and tail remained still. Head-swaying is common behaviour noticed in this snake when it is foraging for food.

Based on the egg counts of 57 preserved females, individual females produce from three to eight eggs each year (Figure 155). Females retain their eggs

Table 32:
Length measurements in millimetres of 222 Eastern Smooth Green Snakes from Nova Scotia

No. of Individuals, Maturity, Sex, Recorder, Date	Body Length Range (Mean)	Total Length Range (Mean)	Tail Length as % of Total Length Range (Mean)
93 Hatchlings J. Gilhen, 1969-1977	70.0-94.0 (80.7)	96.0-129.0 (112.8)	22.9-32.4 (28.1)
1 adult male H. Piers, 1917		415.3	
2 adult males J. S. Bleakney, 1950		336.6-355.6 (346.1)	
39 (38)* adult males J. Gilhen, 1969-1980	197.0-289.0 (226.0)	300.0-444.0 (344.0)	29.9-36.3 (34.1)
11 adult males W. Weller & J. Gilhen, 1971	213.0-285.0 (246.0)	309.0-439.0 (373.7)	31.1-35.1 (33.9)
1 adult female H. Piers, 1899		416.6	
60 adult females J. Gilhen, 1969-1980	212.0-318.0 (257.8)	304.0-449.0 (363.4)	24.9-31.4 (29.1)
15 (11)* adult females W. Weller & J. Gilhen, 1971	217.0-311.0 (258.8)	305.0-423.0 (358.7)	26.5-32.3 (28.6)

*The numbers in parentheses represent the number of individuals which have a complete tail and were measured for tail and total length.

until the latter part of July or early August and then deposit them in damp places under rocks or decaying wood, in open areas where the surface is exposed to the sun. The nest may contain the eggs of one or more females. The largest communal nest, discovered when a rock was turned over on a grassy roadside leading to Great Pubnico Lake, Yarmouth County on August 14, 1977, contained 30 eggs. This nest was probably the result of six to eight females depositing their eggs in that space.

The diet of Eastern Smooth Green Snakes consists largely of moth larvae (Lepidoptera) and spiders (Araneida). However, grasshoppers (Acrididae), leaf hoppers (Cicadellidae), millipedes (Diplopoda) and small terrestrial snails (Zonitidae) are also eaten.

Eastern Smooth Green Snakes retire to their places of hibernation in October. The latest record is October 23, 1935 when one individual was captured at St. Peter's, Richmond County.

Figure 155.

Number of eggs produced by 57 Eastern Smooth Green Snakes from Nova Scotia

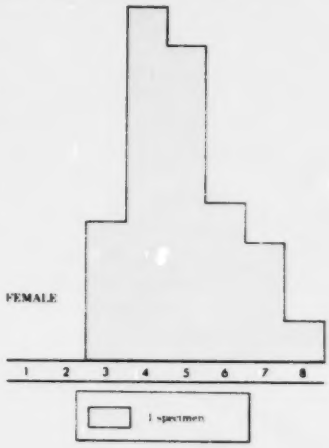
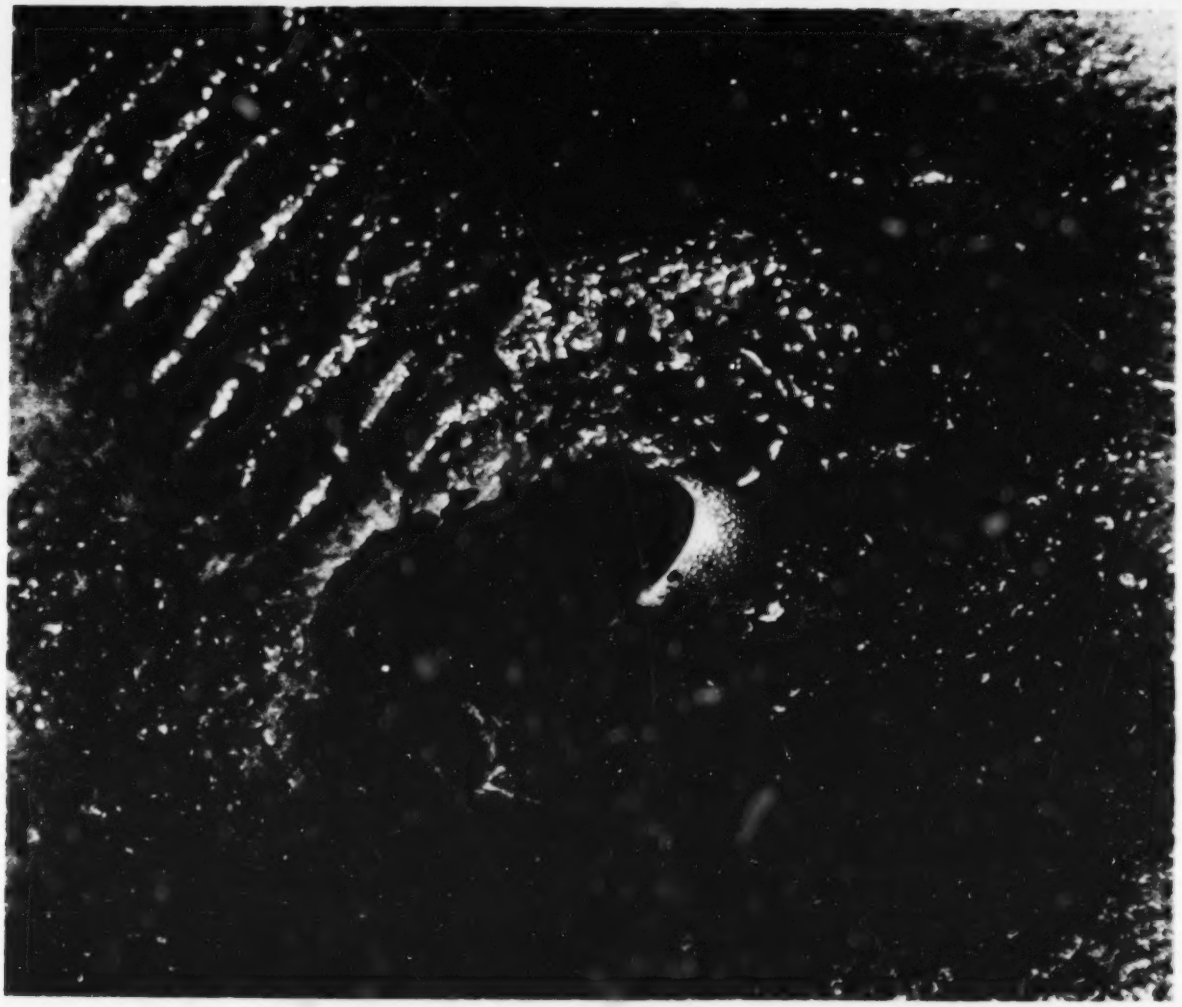


Figure 154.

Eastern Smooth Green Snake foraging along the edge of a grassy roadside at Colpton, Lunenburg County, at 1510 hrs on July 5, 1978

Figure 156.

Eastern American Toad calling at the margin of a boot print on the soft shore of a pond at Elmsdale, Hants County, between 2100 and 2300 hrs on May 2, 1970



Conservation: The vulnerability of the amphibians and reptiles of Nova Scotia

"Though boys throw stones at frogs in sport, the frogs do not die in sport, but in earnest."

from Plutarch, *Water and Land Animals*, 280 B.C.

Man generally has always felt uncomfortable sharing his surroundings with some of the natural inhabitants, including certain amphibians and reptiles. Although conservationists continue to try to educate the public about the ecological importance of these animals, some people still throw stones at frogs, tramp on salamanders, use a stick to clobber snakes and deliberately run over turtles on roads.

This treatment of amphibians and reptiles is documented in the early literature of this province. For example, Captain Campbell Hardy (1855) describes in detail catching a Bullfrog by dangling a fly from the tip of his fishing rod over its head. Hardy wrote,

"Paying no attention to us, or to the rod which was moving about over him, the portly monster eyed the fly with extreme rage. His throat and broad chest were inflated to thrice their usual size, and at last he made an energetic flounder upwards, seized the fly, and fairly hooked himself.

"Such a scene commenced in the muddy pond! As he dived about, his slimy brethren threw themselves upon him with horrible croakings, hugging him in the fashion of a bear, till at last there were half-a-dozen of them, all in a lump.

"In fits of laughter from the strange sight, we 'hove rocks' as the expression is amongst the urchins of Nova Scotia, at the excited mob of frogs, and in the midst of the fray, my fly was disengaged, much to my relief, as I had expected that amputation of the line would have been necessary."

John Matthew Jones (1865) relayed a story, which was told to him by Dr. Gilpin, about the senseless capturing and killing of a Common Snapping Turtle. In his account of this species Jones wrote,

"In 1833, while with some Indians in a canoe on Lake Rossignol, we came upon a snapping turtle basking on a log. With the greatest caution we floated with a light breeze to within twenty yards of it, when with a heavy splash it disappeared. Marking the exact spot, in a moment the canoe was swept over it, and an Indian held the turtle to the bottom of the lake by pressing the paddle upon his back, while another Indian drove a stake through its body and lifted the turtle into the canoe. After decapitation the body crawled about for some twenty-four hours or more, and the severed head snapped at wood, and held so tight that force was used to disengage it."

Jones was obviously aware of the senseless abuse of amphibians and reptiles and he made a valuable contribution to conservation by recognizing the economic importance of the Eastern American Toad. Jones said,

"This poor despised, yet useful creature, looked upon with horror by most people, is one of the farmer's and gardener's best friends. Sallying forth from his mid-day retreat at eventide, he searches the paths and other likely spots where slugs and worms are wont to move, and revels in the gardens where this welcome food is most abundant."

It is ironic that despite man's primitive yet habitual attitude towards amphibians and reptiles he has unknowingly created new and in some cases more favourable habitats for these animals he dislikes. Since early European settlement in Nova Scotia, large areas of woodland have been cleared in the establishing of fishing, farming, lumbering and mining communities. This alteration of the landscape merely interrupted the habitat of some woodland species while enhancing the habitat of others which thrive in open areas. For example, when the land is deforested for agricultural purposes the habitat of the Eastern Redback Salamander, Wood Frog and Northern Ringneck

Snake is destroyed, but the grasslands and the various types of reservoirs (Figure 157) associated with farming activity are ideal habitat for the Eastern American Toad, Green Frog, Northern Leopard Frog, Northern Redbelly Snake, Maritime Garter Snake and Eastern Smooth Green Snake.

Perhaps the most significant influence on the spread and population increase of amphibians and reptiles is the modern road network. Since amphibians and reptiles tend to be most common at the edge of their habitat, the roadsides have opened up large areas of land previously unpopulated by most species. The shallow cattail ponds along the roadsides (Figure 158) and in the gravel pits associated with road construction provide ideal egg-laying sites for amphibians because there are no fish to prey upon the larvae, which develop rapidly in the warm water. The rock-strewn edges of woodlands provide cover for snakes and salamanders, and oviparous snakes and the Eastern Redback Salamander will lay their eggs under these rocks. The frogs and snakes in particular forage along the vegetated roadsides. The Common Snapping Turtle will dig a nest on roadbanks and Wood Turtles will feed on wild strawberries along roadsides near streams. Despite the fact that many of these animals are killed on roads by automobile traffic, the roadsides remain well populated.

Figure 157.

Reservoir used for spraying orchard at Melanson, Kings County, where two adult Green Frogs and Eastern American Toad polliwogs were observed at 1130 hrs on July 4, 1980

Figure 158.

Roadside cattail pond near Gully River, Lunenburg County, where Wood Frog eggs were observed fixed to cattails at 1615 hrs on April 25, 1978. This pond is a breeding site for Yellow-spotted Salamanders, Eastern American Toads, Northern Spring Peepers, Wood Frogs and Northern Leopard Frogs

Another interesting point is that many people decorate their property with rock walls (Figure 159) or place rocks in flower gardens, and salamanders and snakes take advantage of this additional cover. The shed skins of snakes are commonly found within rockwalls.

Minor pollution in the form of boards and doors at abandoned farms (Figure 160) or discarded car doors, other metal objects (Figure 161) and tarpaper around the countryside are often considered eyesores, but these objects provide cover for snakes and frogs. Cardboard discarded by roadside ponds temporarily provides damp cover for transformed salamanders.

In recent years scientists have been greatly concerned about the destruction of aquatic life, particularly fishes in the salmon family, in streams that flow through areas where the soils and rock lack sodium, calcium, magnesium or potassium, the basic substances which act as a buffering or neutralizing agent for acid rain. Records show that between 1952 and 1954 the average rainwater pH

Figure 159.

Rock wall at Armdale, Halifax County, where the shed skins of Northern Ringneck Snakes were found at 0900 hrs on July 17, 1980

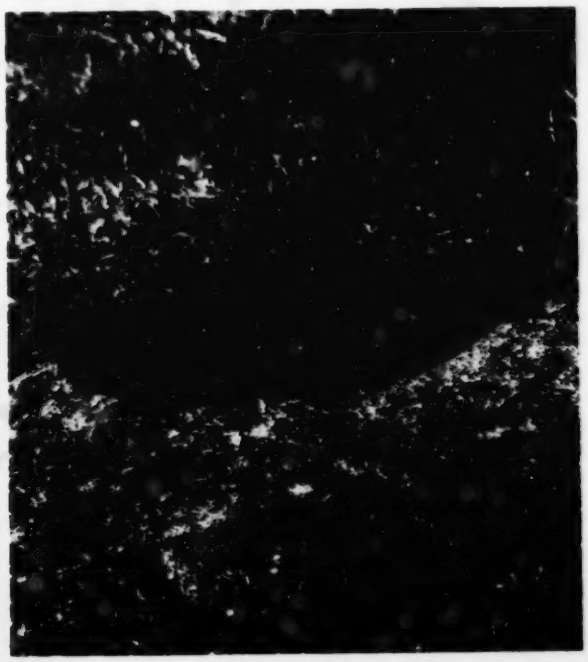
in the Annapolis Valley was 5.7, which is considered to be normal, but records between 1977 and 1978 show an average rainfall pH of 4.7 (Freedman and Ogden, 1981). The pH of a number of streams in Yarmouth, Shelburne, Queens and Guysborough Counties has dropped to 4.7 or less because they lack the essential buffering agents, and these streams will no longer support a population of Atlantic Salmon or Brook Trout (Department of Fisheries and Oceans, 1981). The Tusket River watershed, one of two localities in Nova Scotia where the Acadian Whitefish (a species of game fish known only from Nova Scotia) is found, is one of the areas which has been affected by these severe acid conditions. We do not know what effect such acidity has on Nova Scotian amphibians and reptiles and the less-studied aquatic invertebrates. Scientists have always had difficulty in getting support, particularly financial, to do life-history studies of non-commercial species and we remain in the embarrassing position of not knowing the real extent of the consequences of pollution.

Figure 160.

Abandoned farm at Caledonia, Queens County, where one Maritime Garter Snake and two Northern Redbelly Snakes were observed when a discarded door was turned over in the grass at 1420 hrs on May 8, 1979

Figure 161.

Three Northern Ringneck Snakes were found when this top from a metal drum was lifted away from the boulder in an old field near Harper Lake, Shelburne County, at 1225 hrs on June 7, 1979



The herpetofauna of Nova Scotia can be divided into four major groups:

Group 1
This is the largest group and includes 12 species that are found throughout most of the province. They are flexible in their habitat requirements and do not seem to be greatly affected by the range of climatic conditions. Members of this group include:

Yellow-spotted Salamander
Red-spotted Newt
Eastern Redback Salamander
Eastern American Toad
Northern Spring Peeper
Green Frog
Wood Frog
Northern Leopard Frog
Pickerel Frog
Northern Redbelly Snake
Maritime Garter Snake
Eastern Smooth Green Snake

Group 2
This group of five species is also found on the mainland and Cape Breton Island. Although they do not seem to be greatly affected by the range of climatic conditions, they apparently have more specific habitat requirements than the species in Group 1. Members of this group include:

Blue-spotted Salamander
Four-toed Salamander
Mink Frog
Wood Turtle
Northern Ringneck Snake

Group 3
This group of five species has reached the northeasterly limits of their range in mainland Nova Scotia. Despite the fact that suitable habitats occur on Cape Breton Island, climatic conditions apparently are not favourable there. The optimum temperatures for each species vary and this is evident when comparing the distribution of the following species:

Bullfrog
Common Snapping Turtle
Eastern Painted Turtle
Blanding's Turtle
Northern Ribbon Snake

Group 4
This group includes the three species of marine turtle which are visitors to Canadian waters during the summer. Included in this group are:

Atlantic Ridley
Atlantic Loggerhead
Atlantic Leatherback

The species included in Group 1 are not threatened by present developments in Nova Scotia. However, the all-red or erythristic phase of the Eastern Redback Salamander is found in deciduous woods 153 metres or more above sea level and if these woodlands are deforested for development or expansion of blueberry fields, or to encourage the growth of coniferous woods to support the pulp and paper industry, this colour phase will be threatened.

Because of their specific habitat requirements local populations of the species in Group 2 could be devastated by development. For example, filling in a sphagnum bog could greatly reduce or even exterminate local populations of Four-toed Salamanders.

Although Wood Turtles may be found for a number of kilometres along a major river valley there are perhaps only one or two sand or gravel banks that are natural nesting sites. The removal of gravel from nesting sites along any such streams could be a threat to the continued survival of Wood Turtles. Another problem facing the Wood Turtle is the removal of many individuals from their habitat by people while on fishing or camping trips. Often after the novelty of keeping the turtle as a pet has worn off, it is released in the woods many kilometres from its natural habitat. The person has the satisfaction of observing the turtle and then releasing it, but the turtle begins a solitary life isolated from the breeding population.

The Blanding's Turtle and Northern Ribbon Snake are restricted to south-central Nova Scotia. The entire breeding population of the Blanding's Turtle exists within Kejimkujik National Park. The population seems to be stable there and provided the nesting sites along the sandy shore area of Kejimkujik Lake are protected from public disturbance, the Blanding's Turtle should continue to survive in present climatic conditions.

The Northern Ribbon Snake is more widespread in south central Nova Scotia than the Blanding's Turtle. This snake seems to occur in pockets along the shores of ponds, lakes and streams. On many of the lakes beyond the borders of Kejimkujik National Park an increasing number of lakeshore cot-

tages are being built. If cottagers do not learn to accept the presence of the occasional Northern Ribbon Snake crossing their lawn or foraging along the lakeshore and stop killing all snakes that are found near their cottages, local populations of Northern Ribbon Snakes could be exterminated and the species as a whole will be threatened in Nova Scotia.

Perhaps the most persecuted reptile in Nova Scotia is the Common Snapping Turtle. Because of their large size and aggressive disposition while protecting themselves on land, people are determined to have them destroyed. One of the most common public enquiries I receive at the Nova Scotia Museum is from people who own lakeshore cottages and want to know how to "get rid" of these turtles.

Marine turtles, particularly the Atlantic Loggerhead on the fishing banks and the Atlantic Leatherback along the coast of this province, become entangled in fishing gear and often the fishermen will keep captured individuals tied to their wharf for the curious public to view (Figure 162). Any of these turtles which survive the ordeal of being entangled in fishing gear should be released as soon as possible.

Although some species of amphibians and reptiles native to Nova Scotia are difficult to find and few specimens exist in museum collections, none of these species are in any immediate danger of extinction in this province. However, because the Blanding's Turtle and Northern Ribbon Snake have such a limited range in Nova Scotia they could easily become endangered species here. It would be unprofitable for collectors to try to gather quantities of species such as Bullfrogs and Northern Leopard Frogs, required by biological supply houses, because in this province we do not have the necessary numbers of individuals of those species in any given area and they could not withstand over-collecting on a regular basis.

Perhaps the most important point to be considered by conservationists is the variability of many of the species native to Nova Scotia. If we conserve all populations herpetologists will have a chance to study in detail the variation of each species and gain more insight into the post glacial ancestry of the amphibians and reptiles of Nova Scotia. I have found that most species are not only very variable, particularly in colour and pattern, in any given locality but may be dramatically different in widely separated localities. For example, many individuals of the Blue-spotted Salamander in the Enfield and Elmsdale area of Hants County have shorter tails and are more heavily spotted than many specimens in the Amherst Shore and Lower Shinimicas areas of Cumberland County. Many individuals of the Red-spotted Newt on the plateau of the Cape Breton Highlands are larger than those in the mainland and specimens which lack red spots are not uncommon there.

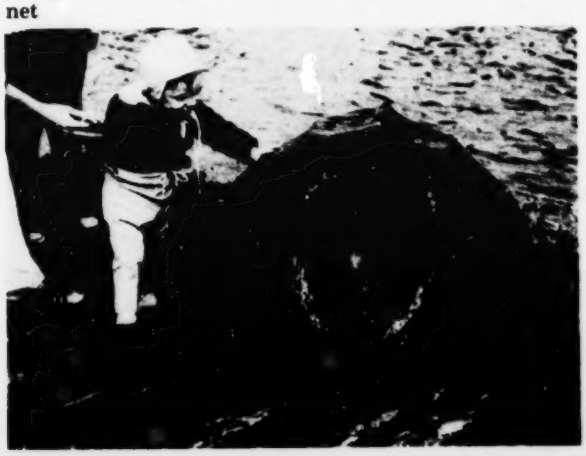
All of the frogs are variable. For example, the general ground colour of the back of many of the male Eastern American Toads in the granite, quartzite and slate rock areas along the Atlantic coast is olive-green while many of those in the red sandstone and conglomerate areas of the northern mainland are reddish-brown. Although I have not had the opportunity to observe the Mink Frog from other regions of this species range, some of the colour patterns noted in Nova Scotia are different from any previously reported in the literature.

The turtles and snakes are also variable. Most of the Eastern Painted Turtles look like intergrades between the Midland and Eastern Painted Turtles.

One of the key characteristics of the four subspecies of the Eastern Ringneck Snake is the presence or absence of ventral spots, as well as the size, number and position of these spots on each ventral scale. Many individuals of the Northern Ringneck Snake in Nova Scotia have ventral spots which look like those on Southern, Prairie and Mississippi Ringneck Snakes.

Figure 162.

An adult Atlantic Leatherback brought to shore at Peggy's Cove after it became tangled in a fisherman's net



Sea Serpents: Reports of supposed sightings in Nova Scotia's coastal waters

In 1864 Rev. John Ambrose published in the *Transactions* of the Nova Scotian Institute of Science a paper concerning two sightings of a sea serpent in St. Margaret's Bay, Nova Scotia.

Ambrose's account of the first sighting reads: "In the Summer of 1846, James Wilson, teacher, and John Boehner, both of Peggy's Cove, being on board a schooner lying off Mill Cove, on the west side of St. Margaret's Bay, saw in the water at a distance, something which they took to be a large fleet of nets. Their attention having been for a few moments drawn off by the appearance of a school of grampuses entering the Bay, they were surprised, on again looking at the supposed fleet of nets, to see it straightening itself out, and moving off so swiftly as to leave a wake as large and as much agitated as that of a schooner in swift motion. They now perceived the object to be a large Serpent, with a head about the size of a barrel, and a body in proportion, and with something like a mane flowing down its neck. It carried its head erect, with a slight inclination forward. A fisherman belonging to Mill Cove, now came rowing with all his fast decreasing strength, to the schooner, and having barely leaped in over the side, fainted with terror on the deck. Wilson thinks the animal was about from seventy to one hundred feet in length. Its colour seemed to be a sort of steel-grey."

Ambrose adds to this account by stating: "George Dauphiney, Esq., of Boutilier's Point, Lower Ward, also saw this, or a similar serpent, near Hackett's Cove, as he was inadvertently rowing over it in his skiff. He made no examination of it, but rowed away from so dangerous a proximity, as fast as possible."

The second account by Ambrose reads: "In the Summer of 1849, Joseph Holland, now living near Port Medway, being in company with Jacob Kedy and two other fishermen, on South West Island, at the west side of the entrance of this Bay, saw something very large and long in appearance, swimming on the surface of the water, at some little distance from the land. Curiosity at length induced the men to launch a flat, and row out for a nearer inspection of the object, which apparently did not perceive them until they had rowed over where it was swimming. They now found it to be no other than an immense snake, about sixty feet in length, and as large in circumference as a puncheon. It was proportioned like an eel, *i.e.*, tapering towards the extremities, with no caudal fin perceptible, but one very high fin, or row of spines, each of about an inch in diameter at the base, erected along its back, serving indeed for a dorsal fin, like the folding fin of the *Thynnus vulgaris*, or albicore. This spinal erection seemed to occupy about one third of its length, each end of it being about equi-distant from the Serpent's extremities; and at a distance, somewhat resembling, in size and appearance, the sail of a skiff. The animal's back was covered with scales, about six inches long and three inches wide, extending in rows across the body, *i.e.*, the longer diameter of scale being in the direction of the circumference of the body. The colour of the back was black. The men had no opportunity of seeing the belly, but what the Americans would call, 'a smart chance' of becoming acquainted with the inside of it; for the creature, perceiving the boat, raised its head about ten feet above water, turned towards it, and opening its jaws, showed the inside of its mouth red in colour and well armed with teeth about three inches long, shaped like those of the cat-fish. The men now thinking it high time to terminate the interview, pulled vigorously for shore, followed for some distance by the snake, which at length gave up the chase and disappeared."

Ambrose continued, "All these accounts are but the recollections of terrified persons, and yet their descriptions of the objects of their terror remark-

ably agree with each other, and with the accounts of the Sea Serpent given by persons of better education, viewing it under safer circumstances.

"A few years ago, one of these Serpents was stranded on Turk's Island, and the description given in one of the public prints by a lady, who saw and examined its dead body, tallies closely with Wilson's account."

These sightings were not the first or last of a supposed sea serpent in Nova Scotian waters. Wallis and Wallis (1955) report in a chapter on "Beliefs about Animals" that Micmac Indians saw a sea serpent near Pictou. Perhaps the great horned snake of Micmac legend was based on sightings of supposed sea serpents. In August 1855, a supposed sea serpent was seen at Green Harbour, Shelburne County. In more recent times, July 1976, along the southwestern coast of this province, a tusked sea creature was seen by a number of fishermen who believed it was a sea serpent.

Scientists suspect that most of the sea creatures seen were not serpents but a species of fish called an oarfish, *Regalecus glesne*. This fish has a manelike dorsal fin and the elongate or eel-shaped body, although comparatively small in girth, grows to a length of 10 meters or more. This species, however, has never been captured in Canadian waters and consequently is not listed by Leim and Scott (1966) in *Fishes of the Atlantic coast of Canada*.

On one occasion a woman reported that she saw a dead sea serpent washed up on the shore at Crystal Crescent Beach, Halifax County. Fred Scott and I examined and identified the remains as the cranium and complete cylindrical vertebral column of an adult Basking Shark, *Cetorhinus maximus*, which was approximately seven to eight meters in length.

The tusked sea animal seen in July 1976 was probably a walrus, since one was photographed at Cape Sable Island, Shelburne County, on September 26 of that year by Mrs. Sidney Smith and companions.

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Salamanders, frogs, turtles and snakes lead really quite secretive lives and this means that they are often misunderstood. In this book the Nova Scotia Museum herpetologist, John Gilhen, gives us a clear picture of how these animals live and interact within the Nova Scotia environment. The book is the result of twenty years of research and contains information for both the general reader and the specialist. Also featured are splendid full-colour scientific illustrations of all Nova Scotia's reptiles and amphibians taken from watercolour paintings by museum zoologist, Fred Scott. These illustrations are also available as a handsome 25″ × 34″ wall poster.

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Printed in Canada

ISBN 0-919680-26-7

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